US ROUTE 460 DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

SUPPLEMENTAL ALTERNATIVES TECHNICAL REPORT

USACE FEDERAL PROJECT NUMBER: NAO-2008-03470 | FHWA FEDERAL PROJECT NUMBER: STP-000S (276) STATE PROJECT NUMBER: 0460-969-059, P101, C501; UPC: 100432

JUNE 2016









ROUTE 460 LOCATION STUDY: FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT SUPPLEMENTAL ALTERNATIVES TECHNICAL REPORT



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SUPPLEMENTAL ALTERNATIVES TECHNICAL REPORT

PREPARED FOR:

THE VIRGINIA DEPARTMENT OF TRANSPORTATION

June 2016

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1.0 INTRODUCTION

The Virginia Department of Transportation (VDOT), in cooperation with the Federal Highway Administration (FHWA) and the United States Army Corps of Engineers (USACE) as joint lead federal agencies, has evaluated options for highway transportation improvements along the existing U.S. Route 460 (Route 460) corridor between Interstate 295 (I-295) in Prince George County and Holland Road (Route 58) in the City of Suffolk, Virginia.

In September 2014, the Draft Supplemental Environmental Impact Statement (SEIS) was issued to analyze five Build Alternatives and a No Build Alternative. Following the publication of the Draft SEIS in September 2014, VDOT determined that none of the five Build Alternatives evaluated over the extent of the study corridor would be viable options based on public comments that were received, input from the resource and regulatory agencies regarding the estimated environmental impacts, including potential Council of Environmental Quality (CEQ) referral, and the cost opinions that had been developed. However, in addition to the Draft SEIS supporting the ability to select the alternatives studied or the No Build Alternative, it also supported combining sections of those alternatives, including the No Build Alternative, to form an alternative not individually evaluated as a standalone alternative in the Draft SEIS.

As a result, VDOT carefully reconsidered each of the Draft SEIS alternatives – in whole, in parts, and in hybrid combination with one another – in order to identify a single alternative that would sufficiently address the identified project Purpose and Need, while minimizing environmental impacts and providing a cost effective project. VDOT, in close coordination with FHWA, developed a Preferred Alternative that would consist of a combination of alternatives evaluated in the Draft SEIS, including the No Build Alternative and Build Alternatives 4, 2N, 3, and 1 (from west to east). This FHWA/VDOT Preferred Alternative consists of implementing the No Build Alternative between I-295 and one mile west of Zuni, upgrading the existing Route 460 between one mile west of Zuni and two miles west of Windsor, and constructing a new four-lane divided highway from west of Windsor to a new Route 460/Route 58 interchange in Suffolk.

In February 2015 the Commonwealth Transportation Board (CTB) approved the location for the Route 460 corridor improvements, consistent with the FHWA/VDOT Preferred Alternative. Additionally, the USACE stated in January 2015² that it did not find reason to disagree with the assessment that FHWA/VDOT's Preferred Alternative appears to be the Least Environmentally Damaging Practicable Alternative (LEDPA), noting that the USACE comments do not constitute a final LEDPA determination or indication of a permit decision (Note: the Preferred Alternative identified in tables and figures throughout the Final SEIS and Technical Reports refers to the FHWA/VDOT Preferred Alternative).

Prepared in accordance with the implementing regulations of the National Environmental Policay Act (NEPA) at 23 CFR §771.130 and 40 CFR §1502.9(c), the Final SEIS addresses public and agency comments received on the September 2014 Draft SEIS, documents the FHWA and VDOT identified Preferred Alternative and the updated analysis associated with the FHWA/VDOT Preferred Alternative and document the action of the CTB.

² Olsen, Colonel Paul B. Letter to Aubrey Lane, Jr. 9 Jan. 2015. Norfolk, Virginia.

1.1 SUPPLEMENTAL ALTERNATIVES TECHNICAL REPORT

In support of the Final SEIS, the purpose of this Supplemental Alternatives Technical Report is to describe the alternative analyses and evaluation processes that have contributed to the development and selection of alternatives, as well as the identification, recommendation, and refinement of the FHWA/VDOT Preferred Alternative. This report builds upon the previous analyses and comparative evaluation conducted for the alternatives included in the Draft SEIS as well as the alternatives evaluated in the 2005 Draft Environmental Impact Statement (DEIS), 2008 Final EIS, and Record of Decision (ROD). Descriptions of these alternatives are provided in detail in the *Alternatives Technical Report* (VDOT, 2014e).

1.2 BACKGROUND

In May 2005, FHWA published a Draft Environmental Impact Statement (DEIS) for the Route 460 Location Study that evaluated three candidate build alternatives (CBAs) as well as the No Build Alternative and Transportation System Management (TSM) Alternative. Following the publication of the 2005 DEIS, VDOT held two public hearings presenting the technical findings of the draft analysis. In November 2005, the CTB selected the new location alternative south of existing Route 460, with an alignment shift in Isle of Wight County to reduce residential and wetland impacts (referred to as Modified CBA 1) as the preferred alternative. A Final Environmental Impact Statement (FEIS) was prepared that analyzed the environmental consequences of the preferred alternative in greater detail and was approved by FHWA in June 2008. FHWA issued a Record of Decision (ROD) in September 2008 selecting Modified CBA 1 to address the identified Purpose and Need. In November 2012, FHWA completed a NEPA Re-evaluation of the FEIS and in particular, Modified CBA 1, giving consideration to funding the project through the implementation of tolls. In reviewing the information presented in the 2008 FEIS and the 2012 NEPA Re-evaluation, the USACE indicated that the Commonwealth's preferred alternative did not appear to be the LEDPA when compared to improving the existing road. Further development of additional information and analyses of the Commonwealth's preferred alternative resulted in an increase in the acreage of wetlands identified in the Modified CBA 1 corridor compared to the acreage of wetlands presented in the 2008 FEIS. In 2013, FHWA and USACE determined that the preparation of an SEIS would be necessary in order to analyze new information with a bearing on the environmental impacts, particularly aquatic resource impacts. The SEIS also was determined to be necessary in order for the USACE to fulfill its statutory obligations under NEPA and as part of its decision making process to issue or deny authorization for impacts associated with the Route 460 corridor improvements.

The Draft SEIS was published in September 2014 and presented at three Location Public Hearings that took place in October 2014.

The Draft SEIS provided detailed analysis of five Build Alternatives (Alternatives 1-5) that met the Purpose and Need, including two alternatives on new alignment (Alternatives 1 and 3), one alternative with improvements to existing Route 460 (Alternative 4), alternatives that included a combination of new location alignment (with bypasses of the towns) with varying improvements to existing Route 460 between the towns (Alternatives 2N/S and 5N/S), and the No Build Alternative. The No Build Alternative included all planned and programmed transportation improvements in the study area that had been approved and adopted for implementation by 2040.

Following the publication of the Draft SEIS, VDOT determined that none of the five Build Alternatives evaluated over the extent of the study corridor would be viable options based on public comments that were received, input from the resource and regulatory agencies regarding the estimated environmental impacts including potential CEQ referral, and the cost opinions that had been developed. In order to identify a single alternative that was less impactful, as well as less costly, while sufficiently addressing the Purpose and Need, VDOT explored a combination of segments from the Draft SEIS alternatives in various configurations to develop hybrid alternatives. The goal of the hybrid development was to arrive at a recommendation for a preferred alternative that could be considered the LEDPA while sufficiently addressing the project's Purpose and Need and providing a cost effective solution.

In January 2015, VDOT, in close coordination with FHWA reconsidered the alternatives studied in the Draft SEIS and developed a 52-mile FHWA/VDOT Preferred Alternative, which included the No Build Alternative over most of its length (36 miles), with portions of four alternatives from the Draft SEIS (4, 2N, 3, and 1) for 16 miles. Since the identification and approval of the location of the FHWA/VDOT Preferred Alternative, further refinements were applied in order to avoid and minimize impacts to the greatest extent practicable. The FHWA/VDOT Preferred Alternative, including these further refinements, has been carried forward for detailed evaluation in the Final SEIS.

1.3 PURPOSE AND NEED

The purpose of the improvements to the Route 460 corridor is to construct a facility that is consistent with the functional classification of the corridor, sufficiently addresses safety, mobility and evacuation needs, and sufficiently accommodates freight traffic along the Route 460 corridor between Petersburg and Suffolk, Virginia.

The following needs have been identified for the project:

- Address roadway deficiencies: Route 460 is based on outdated geometric standards.
- Improve safety: Fatality rates for Route 460 are higher than other comparable rural roadways in Virginia.
- Accommodate increasing freight shipments: Truck percentages for Route 460 are higher than
 national averages for rural roads with a similar functional classification. Truck volumes are also
 forecast to grow due to expansions at the Port of Virginia.
- Reduce Travel Delay: Future traffic volumes will result in increased travel delays on Route 460 due to capacity limitations at traffic signals and due to the current design deficiencies.
- Provide adequate emergency evacuation capability: Route 460 is a designated hurricane evacuation
 route for Southside Hampton Roads communities, yet during recent events, the road was closed
 due to effects caused by these storms.
- Improve strategic military connectivity: Route 460 is a designated part of the Strategic Highway Network (STRAHNET) by the Department of Defense (DOD) and FHWA.
- Support local economic development plans: In addition to statewide and regional economic
 development needs, jurisdictions along the Route 460 study area have identified economic
 development priorities related to transportation improvements.

Through the evaluation of hybrid alternatives, which is detailed in the *Supplemental Alternatives Technical Report* (VDOT, 2016e), the following were identified as key improvements necessary for addressing the Purpose and Need, even if these improvements involved a hybrid alternative less than the full length of the Route 460 corridor.

- Improvements are needed along Route 460 at the Blackwater River to address longstanding flooding issues associated with safety and evacuation concerns and roadway deficiency.
- Improvements are needed at Route 58/Route 460 to provide efficient traffic movements to decrease travel time, facilitate increased freight mobility, and better accommodate emergency evacuation.
- Improvements to the eastern portion of the corridor to improve safety, as this area has the largest number of conflict points compared to the rest of the corridor; enhancements to travel time, freight mobility, and evacuation from the coastal areas would be better realized with improvements to the eastern portion of the corridor.

Based on the identification of these key components necessary for addressing the Purpose and Need, geographic limits for the hybrid alternative were refined within the eastern portion of the study corridor, where these key project components were focused and the elements of need had been demonstrated in the Draft SEIS as more pronounced. In developing hybrids, it also was important to consider opportunities to minimize environmental impacts, such as displacements and aquatic resources, and costs. Following a detailed evaluation of hybrid alternatives that focused on the eastern portion of the study corridor, FHWA/VDOT Preferred Alternative was ultimately identified as the most effective improvement option for the 16 miles for which the improvements were considered; it best addresses the project's Purpose and Need, while balancing cost, displacements, and wetlands.

1.4 FINAL SEIS ALTERNATIVES

Two alternatives are included in the Final SEIS – the FHWA/VDOT Preferred Alternative and the No Build Alternative. Following is a description of each alternative.

1.4.1 No Build Alternative

The No Build Alternative has been included to serve as a baseline for comparison of future conditions and impacts. The No Build Alternative includes all planned and programmed transportation improvements within the study area that have been approved and adopted for implementation by 2040, as identified in the VDOT Six Year Improvement Program (SYIP). These planned and programmed improvements would be developed and implemented independent of the implementation of the FHWA/VDOT Preferred Alternative. The No Build projects within the study area and projects that have the potential to affect capacity within the study area are listed in **Table 1.4-1**.

4

VDOT Locality **UPC/MPO ID Description** Construction of added left turn lane on westbound Route 460 at Enterprise 100499 Drive (Route 657). Construction of added left turn lanes on northbound Bull Hill Road (Route 630) Prince 82849 onto Route 460 in Prince George County. George Construction of right turn lanes on Courthouse Road (Route 106) at its 105110 intersection with Prince George Drive (Route 616). 104847 Construction of added left turn lane on Route 156. Improvements to Route 627 by widening, improving the drainage, and Surry 107529 straightening the roadway. N/A No projects listed. Sussex Southampton N/A No projects listed. Construction of added left and right turn lanes on Courthouse Highway (Route 58297 258) at its intersection with Scotts Factory Road (Route 620). Isle of Wight Construction of a right turn lane on Turner Drive (Route 644) at the intersection 103021 with Benns Church Boulevard (Route 10/32). Improvements to drainage and stormwater management facilities along Pruden 104333 Boulevard (Route 460). Intelligent transportation system (ITS) improvements to 11.6 miles of the 102994 Suffolk Bypass (Route 58) from the City of Chesapeake to Holland Road. Reconstruction with added capacity on Route 58/Holland Road between the 100937 Suffolk Route 58/13/32 bypass to just west of Manning Bridge Road. Intersection improvements to Suffolk Bypass Off-Ramp at Godwin Boulevard. 102998 Construction of second exclusive right-turn lane and traffic signal improvements. Improvements to the intersection of Godwin Boulevard (Route 10) and Kings 104332 Highway (Route 125).

Table 1.4-1: No Build Projects within the Route 460 Study Area Jurisdictions

Source: Virginia Department of Transportation FY 2016 Final SYIP; Hampton Roads 2040 Long Range Transportation Plan: Committed and Candidate Transportation Projects, September 2014.

1.4.2 FHWA/VDOT Preferred Alternative

The FHWA/VDOT Preferred Alternative is a 52-mile corridor between I-295 in Prince George County and Route 58 in Suffolk. **Figure 1.4-1** illustrates the FHWA/VDOT Preferred Alternative compared to the Build Alternatives from the Draft SEIS. Following is a description of the FHWA/VDOT Preferred Alternative, from west to east:

- from I-295 to approximately one mile west of Zuni the No Build Alternative would be implemented (approximately 36 miles);
- from approximately one mile west of Zuni to two miles west of Windsor the existing US 460 would be upgraded to a four-lane divided highway and include a new bridge across the Blackwater River to eliminate long standing flooding problems (approximately 4 miles);
- from approximately two miles west of Windsor to the US 460/58 interchange in Suffolk, a new four-lane divided highway would be constructed, running north around Windsor, then east of Windsor running south of the existing US 460 (approximately 12 miles).

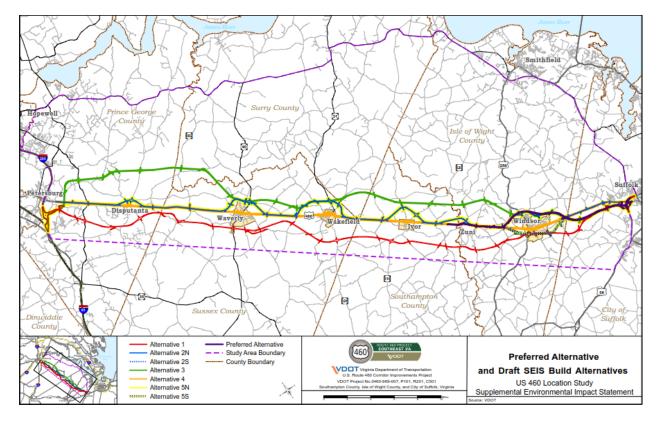


Figure 1.4-1: FHWA/VDOT Preferred Alternative and Draft SEIS Build Alternatives

1.4.3 Inventory Corridor and Design Corridor

In order to identify resources along the Build Alternatives analyzed in the Draft SEIS, a 500-foot wide Inventory Corridor was developed to identify resources within a reasonable proximity of each alignment. None of the alternatives were anticipated to impact all of the resources identified within their respective Inventory Corridors as these corridors did not reflect the actual impacts of each of the alternatives in comparison to one another. Instead the Inventory Corridors were developed for the purposes of providing greater flexibility to further avoid and minimize impacts as design advanced.

In order to estimate impacts and compare alternatives, the conceptual designs and typical sections were applied to each Build Alternative in the Draft SEIS to develop a Design Corridor to represent the likely "footprint" for each alternative. The reported impacts in the Draft SEIS were based upon the Design Corridor, which included roadway width, proposed right-of-way, and construction limits. The Design Corridor for each alternative was able to be shifted within the Inventory Corridor to avoid or minimize impacts to resources with knowledge of the consequences of those shifts. In addition, both the SEIS Inventory and Design Corridors were adjusted as necessary to account for design elements associated with each Alternative, including interchanges, at-grade intersections, side road overpasses, interface geometry with bypasses, etc. Details regarding the design elements that were factored into the development of each alternative and the typical sections developed for them are included within the appendices of the *Alternatives Technical Report* (VDOT, 2014e).

Design and engineering were advanced in order to develop the permit application for the FHWA/VDOT Preferred Alternative, which requires that the Design Corridor, a planning level design, be refined to understand the specific area to be impacted by the project, known as the Limits of Disturbance (LOD). As described in the sections that follow, the typical sections were refined to more accurately reflect the

anticipated LOD, which includes both temporary and permanent impacts, including stormwater management facilities and construction access. To the extent practicable, the LOD was developed to avoid and minimize impacts to resources, including wetlands and streams. This LOD has been used to calculate predicted impacts of the FHWA/VDOT Preferred Alternative.

2.0 SEIS ALTERNATIVES

2.1 DRAFT SEIS ALTERNATIVES

The Draft SEIS and previous *Alternatives Technical Report* (VDOT, 2014e) provided detailed analysis of five Build Alternatives (Alternatives 1-5) that met the Purpose and Need for the project. In addition, a No Build Alternative was included for analysis. Along each of the individual alignments, a variety of conceptual design elements were considered including interchanges, intersecting road overpasses, and the transition between the existing roadway improvements and new location bypasses. Other design elements were applied as necessary, based on professional engineering judgment.

2.2 FINAL SEIS PREFERRED ALTERNATIVE DEVELOPMENT

Following the issuance of the Draft SEIS and based on public comments that were received, input from the resource and regulatory agencies regarding the estimated environmental impacts including potential CEQ referral, and the cost opinions that had been developed, VDOT determined that none of the five Build Alternatives evaluated over the extent of the study corridor would be viable options to best balance anticipated resource impacts with project cost and need. In order to identify a single alternative that was less impactful, as well as less costly, while sufficiently addressing the Purpose and Need, VDOT explored a combination of segments from the Draft SEIS alternatives in various configurations to develop hybrid alternatives. The goal of the hybrid development was to arrive at a recommendation for a preferred alternative that could be considered the LEDPA while adequately addressing the project's Purpose and Need and providing a cost effective solution. Following the development of initial hybrids, as described below, further refinement and modifications were analyzed and evaluated in an effort to identify FHWA/VDOT's recommended Preferred Alternative.

While developing and analyzing theses hybrids, consideration was given to the viability of tolling. As the hybrids were further refined, tolling was determined not to be a viable option as the hybrid combinations and configurations considered included variations of tolled and untolled alternatives from the Draft SEIS, including improvements along existing Route 460 where tolling would be impractical due to lack of limited access. For the areas that would be limited access, the revenue anticipated to be generated by the facility was expected to be insufficient to cover the cost of installation, operation, and maintenance of the required tolling infrastructure and equipment. As a result, tolling is not being considered for the FHWA/VDOT Preferred Alternative.

The following sections describe the hybrid development, refinement, and modification that followed the Draft SEIS as well as the ultimate selection of the FHWA/VDOT Preferred Alternative.

2.3 HYBRID DEVELOPMENT AND EVALUATION

The **Executive Summary** and **Section 2.3.6** of the Draft SEIS described the potential to advance a hybrid alternative as a preferred alternative in the Final SEIS, noting that decision makers could combine sections of multiple alternatives to advance an alternative that balances cost, impacts and the alternative's

effectiveness at meeting the primary components of the Purpose and Need. VDOT evaluated combination of sections of the five Build Alternatives, as well as the No Build Alternative analyzed in the Draft SEIS to form hybrid conceptual alternatives. All hybrids are comprised of portions of the No Build and the Build Alternatives analyzed in the Draft SEIS.

2.3.1 Initial Hybrids Considered

VDOT's development of initial hybrids went through many iterations starting with the development of end-to-end combinations and/or spot improvements along the length of the study corridor, then looking at shorter segments that focused on either end of the study corridor. As the process continued, adjustments to the typical sections were made in an effort to reduce environmental impacts and costs. **Table 2.3-1** summarizes the variety of hybrids initially considered, the combination of Draft SEIS Alternative segments comprising each hybrid and the issues associated with each initial hybrid. This process allowed VDOT to understand the benefits and flaws associated with the variety of hybrids initially considered and to help identify the priorities of the project. Graphic illustrations of the initial hybrids are included in **Figures 2.3-1** through 2.3-9.

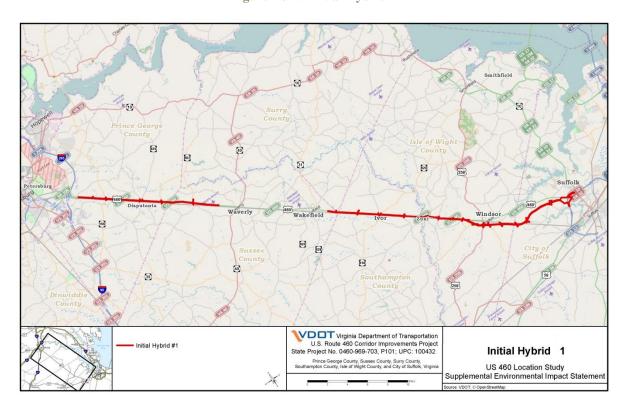


Figure 2.3-1: Initial Hybrid 1

Prince George
County

Bis of Wight
County

Sursor

Surfolk

Surfol

Figure 2.3-2: Initial Hybrid 2





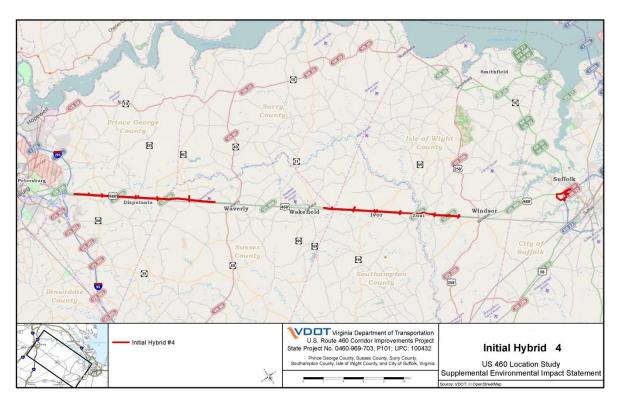
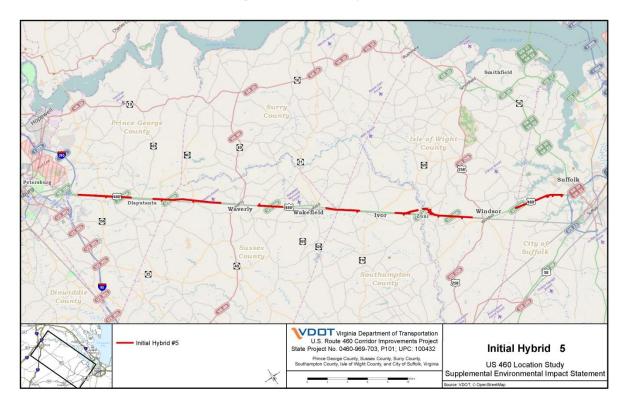


Figure 2.3-4: Initial Hybrid 4

Figure 2.3-5: Initial Hybrid 5



Prince George
County

Prince George
County

Bussey
County

Surfolk

Surfolk

Surfolk

Surfolk

Southampton
County

Southampton
County

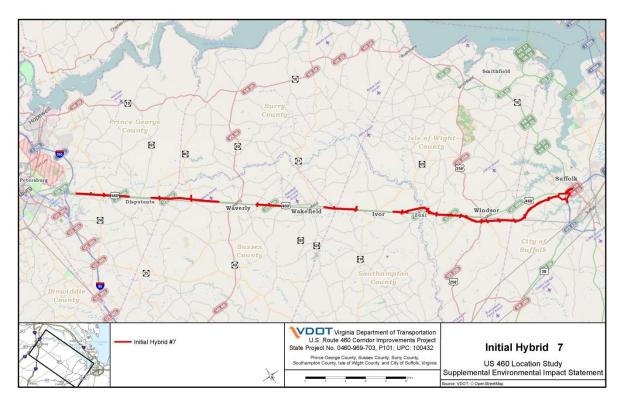
Southampton
County

Southampton
County

Surfolk

Figure 2.3-6: Initial Hybrid 6





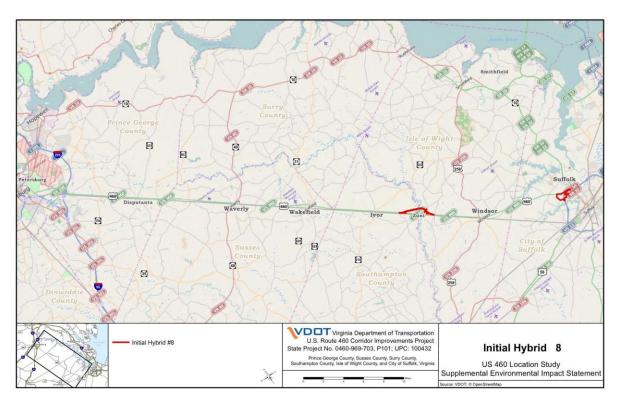


Figure 2.3-8: Initial Hybrid 8



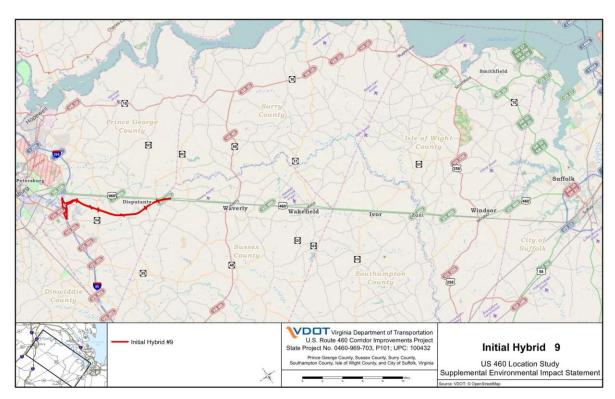


Table 2.3-1: Initial Hybrids Evaluated

| Initial Hybrids | Draft SEIS Alternative Segments | Result of Evaluation* |
|--|---|---|
| 1) Improvements along existing Route 460 between Prince George to west of Waverly and east of Wakefield to west of Windsor with new location from west of Windsor (bypass south of Windsor) to the Eastern Terminus (new system to system interchange). | Alternatives 4, 2S, 1, and No Build | Not carried forward because of wetland impacts (255 Ac.) and cost (\$1.025 B). |
| 2) Improvements along existing Route 460 between Prince George to west of Waverly, east of Wakefield to west of Zuni, and east of Zuni to west of Windsor, with new location on bypasses north of Zuni and Windsor, and from Windsor to the Eastern Terminus (new system to system interchange). | Alternatives 4, 2N, 3, and No Build | Not carried forward because of wetland impacts (209 Ac.) and cost (\$1.051 B). |
| 3) Improvements along existing Route 460 between Prince George to west of Waverly and east of Wakefield to west of Windsor with new location from west of Windsor (bypass north of Windsor) to the Eastern Terminus (new system to system interchange). | Alternatives 4, 2N, 3, and No Build | Not carried forward because of wetland impacts (187 Ac.) and cost (\$998 M). |
| 4) Improvements along existing Route 460 between Prince George to west of Waverly and east of Wakefield to west of Windsor and improvements to the existing Eastern Terminus interchange. | Alternatives 4 1,and No Build | Not carried forward because of wetland impacts (129 Ac.) and cost (\$677 M). |
| 5) Improvements along existing Route 460 between towns with bypass north of Zuni. | Alternatives 4, 2, and No Build | Not carried forward because of wetland impacts (100 Ac.) and cost (\$677 M). |
| 6) Improvements along existing Route 460 between towns with new location on bypasses north of Zuni and Windsor, and from Windsor to the Eastern Terminus (new system to system interchange). | Alternatives 4, 2N, 3, and No Build | Not carried forward because of wetland impacts (149 Ac.) and cost (\$858 M). |
| 7) Improvements along existing Route 460 between all of the towns, from Route 295 to Route 58 with new location on bypasses north of Zuni and south of Windsor, and from Windsor to the Eastern Terminus (new system to system interchange). | Alternatives 4, 2S, 1, and No Build | Not carried forward because of wetland impacts (205 Ac.) and cost (\$885 M). |
| 8) Bypass north of Zuni and new location for the Eastern Terminus (new system to system interchange). | Alternatives 2, 1, and No Build | Not carried forward because it does not adequately address the Purpose and Need for economic development, freight movement, and safety. |
| 9) New location between Western Terminus and east of Disputanta, providing a system to system interchange at Route 295 and bypassing Disputanta to the south. | Alternatives 1 and No Build | Not carried forward because it does not adequately address the Purpose and Need for economic development, freight movement, and safety. |

^{*} Cost includes estimated values for engineering, right-of-way acquisition, environmental mitigation, construction, and contingency.

As listed in **Table 2.3–1**, the initial hybrids, in their entirety within the study corridor, were eliminated due to one or more reasons – they were too impactful, too costly, or did not adequately address the project Purpose and Need. As a result, VDOT further refined the evaluation of hybrid alternatives, by exploring smaller portions of the initial hybrids that would better balance impacts and cost, while adequately satisfying the Purpose and Need.

Through this evaluation, the following were identified as key improvements necessary for addressing the individual elements of the Purpose and Need, even if these improvements involved a hybrid alternative less than the full length of the Route 460 corridor.

- Improvements that meet current design standards are needed along Route 460 at the Blackwater River to address longstanding flooding issues which relate to the safety, emergency evacuation, and roadway deficiency elements of the Purpose and Need.
- Improvements are needed at the Route 58/Route 460 interchange to provide efficient high-speed traffic movements between the two facilities. The Purpose and Need elements related to travel time, freight mobility, military connectivity, and emergency evacuation need to be addressed at this interchange.
- Improvements to the eastern portion of the corridor are needed as this area has the largest number
 of conflict points compared to the rest of the corridor. The Purpose and Need elements related to
 safety would be addressed and better realized with improvements to the eastern portion of the
 corridor.

Based on the identification of these key components, VDOT reexamined the initial hybrids to consider sections in the eastern portion of the study corridor, where these key project components were focused and the elements of need had been demonstrated in the Draft SEIS as more pronounced. As a result, the eastern 16 miles of the Route 460 study corridor formed the basis for a refined hybrid analysis. West of Zuni was established as the new western limit within which the refined hybrid analysis was focused in order to ensure that flooding issues on Route 460 associated with the Blackwater River would be addressed. The Eastern Terminus at Route 58 identified in the Draft SEIS was maintained as the eastern limit for analysis. While taking into account costs and in an effort to focus improvements in the corridor where they could most effectively address the Purpose and Need, no planned improvements were considered beyond the western limit, and the No Build Alternative was recommended for this remaining portion of the corridor.

2.3.2 Refined Hybrids Considered

Twelve refined hybrids were developed that focused on the area between west of Zuni and Suffolk. These 12 refined hybrids combined the No Build Alternative between Prince George and west of Zuni with variations of the Draft SEIS Alternatives through the following four areas to better compare impacts and costs between alternatives:

- Area 1: West of Zuni to east of Zuni around Zuni along new location on the north (Alternative 2) or through Zuni along existing Route 460 (Draft SEIS Alternative 4);
- Area 2: East of Zuni to west of Windsor along existing Route 460 (Draft SEIS Alternative 4);
- Area 3: West of Windsor to east of Windsor along new location around Windsor on the north (Draft SEIS Alternative 2N), through Windsor along existing Route 460 (Draft SEIS Alternative 4), or around Windsor on the south (Draft SEIS Alternative 2S); and
- Area 4: East of Windsor to Route 58 along existing Route 460 (Draft SEIS Alternative 4) or along new location on the south connecting to a new system to system interchange (Draft SEIS Alternatives 1 and 3).

A graphic illustration of the four areas noted above and the corridors considered within each area is shown on **Figure 2-10**.

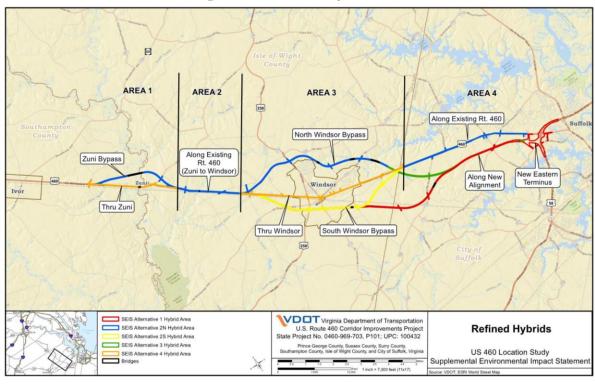


Figure 2.3-10: Refined Hybrid Corridors

Within the limits for the refined hybrid analysis, opportunities were considered to minimize environmental impacts, such as displacements and aquatic resources, and to minimize costs when comparing the refined hybrids to the Draft SEIS alternatives and the initial hybrids discussed above. The refined hybrids were then compared based upon this information.

The twelve refined hybrids generally fell into two groups based on the section between Windsor and Suffolk: those that remained on the existing Route 460 with no new interchange at Route 58, and those that were on new location south of Route 460 with a new interchange. The results of the analysis of the refined hybrids is summarized in **Table 2.3-2**. At this point in the analysis wetland impacts were assessed using the results of the photointerpretation that was performed for the Draft SEIS, as that was the latest wetland information available for all of the alternatives at the time of evaluation.

To better compare the impacts and costs associated with each refined hybrid, as well as to identify potential opportunities for avoiding and minimizing impacts, additional engineering was performed to further develop the assumptions discussed in the Draft SEIS and applied in the refined hybrid analysis. While the original Draft SEIS assumptions remain valid, these refinements were an appropriate next step to further evaluate each of the refined hybrid's features and benefits. Following is a description of the engineering refinements that were incorporated to better quantify the impacts and costs associated with each of the refined hybrids.

<u>Typical Section Fill Height</u>: The Typical Sections used for the Draft SEIS are located in **Sections 4.1.3.1 through 4.1.3.3** in the *Alternatives Technical Report* (VDOT, 2014e). Due to the undulating terrain interspersed throughout the corridor, as well as the embankments assumed for each road overpass and interchange, the typical section for alignment on new location was assumed to have an average fill height

of seven feet. Since the alignment proposed for new location on the eastern 12 miles is on land that is relatively flat, the average fill height was reduced to two feet. This resulted in a reduction in the design corridor width of Typical Section A from 200 feet to 180 feet. Typical Section C was the other representative typical section from the Draft SEIS included in the refined hybrid alignments; however, this section represented the roadway section through the built up areas and was assumed to be at-grade; consequently, the design corridor width of 105 feet remains unchanged from the Draft SEIS.

<u>Side Street Impacts at Intersections</u>: By carrying forward the same change in fill height assumptions applied to the Draft SEIS typical sections, the typical length of the side streets impacted at intersections was reduced from 750 feet to 500 feet, and the width of the impact was reduced from 120 feet to 95 feet.

<u>Utility Relocation Assumptions</u>: The Draft SEIS assumed that all design corridor crossings of electric transmission lines would result in the relocation of two transmission towers. Due to refined engineering, the impact to these towers was avoided. Additionally, the Draft SEIS assumed that all franchise utility crossings would result in the project incurring the cost to relocate the utility across the entire design corridor. Similarly, the refined engineering was able to avoid many of the utilities, reducing the relocations to approximately 25 percent.

2.3.3 Refined Hybrids Considered

The various combinations of these areas, including the refinements to design discussed above, were assessed focusing on wetland impacts, number of displacements, and cost, as summarized in **Table 2.3-2**. Refer to **Appendix B** for the detailed listing of these items for each combination. The metrics are further defined as follows:

- Wetland impacts: Total area of photointerpreted wetland acres within the Refined Hybrid design corridor boundary (assessed using photointerpretation, as this was the latest available wetland information at the time of analysis).
- Displacements: Total number of property displacements within the Refined Hybrid design corridor boundary, based on design refinements, in the following four categories: residential, commercial, farming, and non-profit.
- Project cost: Based on the methodology described in the *Alternatives Technical Report* (VDOT, 2014e) and further refined as described in **Section 2.4.2** below. The cost categories are construction, mobilization, construction engineering and inspection (CEI), engineering, environmental mitigation, utility relocation, right-of-way acquisition, and contingency.

The twelve refined hybrids generally fell into two groups based on the section between Windsor and Suffolk: those that remained on the existing Route 460 with no new interchange at Route 58, and those that were on new location south of Route 460 with a new interchange. The results of the analysis of the refined hybrids is presented in **Table 2.3-2**.

Table 2.3-2: Refined Hybrids

| Refined Hybrids | Draft SEIS Alternative Segments | Photo-interpreted Wetland Impacts (Ac) | Displacements (No.) | Cost (Mil \$) | | |
|--|------------------------------------|---|---------------------|------------------|--|--|
| Along Existing Route 460 East of Windsor | | | | | | |
| 10) Zuni bypass, existing Route 460, Windsor bypass north; existing Route 460 | Alternatives 4 and 2N | 49 | 23 | 393 | | |
| 11) Through Zuni, existing Route 460, Windsor bypass north; existing Route 460 | Alternatives 4 and 2N | 26 | 27 | 338 | | |
| 12) Zuni bypass, existing Route 460, through Windsor; existing Route 460 | Alternatives 4 and 2 | 32 | 45 | 367 | | |
| 13) Through Zuni, existing Route 460, through Windsor; existing Route 460 | Alternative 4 | 10 | 50 | 312 | | |
| 14) Zuni bypass, existing Route 460, Windsor bypass south; existing Route 460 | Alternatives 4 and 2S | 88 | 25 | 391 | | |
| 15) Through Zuni, existing Route 460, Windsor bypass south; existing Route 460 | Alternatives 4 and 2S | 66 | 30 | 337 | | |
| Along New Location I | East of Windson | r to a New Eastern Terr | minus | | | |
| 16) Zuni bypass, existing Route 460, Windsor bypass north; along new location with new Eastern Terminus | Alternatives 4, 2N, 3, and 1 | 74 | 17 | 480 | | |
| 17) Through Zuni, existing Route 460, Windsor bypass north; along new location with new Eastern Terminus | Alternatives 4, 2N, 3, and 1 | 52 | 22 | 427 | | |
| 18) Zuni bypass, existing Route 460, through Windsor; along new location with new Eastern Terminus | Alternatives 4, 2, 3, and 1 | 59 | 40 | 448 | | |
| 19) Through Zuni, existing Route 460, through Windsor; along new location with new Eastern Terminus | Alternatives 4, 3, and 1 | 37 | 45 | 394 | | |
| 20) Zuni bypass, existing Route 460, Windsor bypass south; along new location with new Eastern Terminus | Alternatives 4, 2S and 1 | 130 | 16 | 507 | | |
| 21) Through Zuni, existing Route 460, Windsor bypass south; along new location with new Eastern Terminus | Alternatives 4, 2S and 1 | 108 | 21 | 453 | | |

Note: Highlighted rows denote refined alternatives carried forward for further analysis.

From each of these groups of refined hybrids, identified in **Table 2.3-2**, VDOT identified one option that best balanced anticipated wetland impacts, displacements and cost most effectively, compared to the other similar refined hybrids. From the first group (remaining on existing Route 460 east of Windsor), Refined Hybrid 11 was selected, due to the potential for reduction in wetland impacts, as well as costs. From the second group (new location east of Windsor along the Draft SEIS Alternative 3 alignment with a new interchange), Refined Hybrid 17 was selected for continued evaluation, because it adequately addressed the key project elements and Purpose and Need, while providing a cost effective solution that balanced anticipated wetland impacts and displacements.

In addition to considering the key factors outlined above, the practicability of each hybrid was examined. To be practicable, an alternative must be available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall purposes. In identifying the refined hybrids appropriate for further evaluation, VDOT determined that a refined hybrid through the Town of Windsor

was not practicable due to the substantial impacts to existing homes, businesses, and other important components of the community. Furthermore, a bypass around the Town of Windsor was considered to offer more effective operational benefits over improvements through the Town, such as improved traffic mobility and travel time. Therefore, hybrids that did not bypass Windsor were not considered further. While some of the Refined Hybrids had less wetland impact, they either cost more or had substantially greater displacements and were not practicable. Similarly, projects with fewer displacements were more costly or had substantially more wetland impacts. The refined hybrids selected best balanced all of these factors. Following is a brief description of the two refined hybrids selected for consideration.

Refined Hybrid 17 – the existing Route 460 would be upgraded to a four-lane divided highway from west of Zuni to west of Windsor. From west of Windsor to Route 58 a new four-lane grade separated divided highway would be constructed. This would include a new system to system interchange with free-flow ramps at Route 58. The new highway alignment would run north around Windsor (i.e. bypass) and then south of the existing Route 460 from east of Windsor to Route 58. This refined hybrid is a combination of Draft SEIS Alternatives 4, 2N, 3, and 1, and is shown graphically in **Figure 2.3-11**.

Refined Hybrid 11 – the existing Route 460 would be upgraded to a four-lane divided highway from west of Zuni to west of Windsor and from east of Windsor to Route 58. From west of Windsor to east of Windsor a new four-lane grade separated divided highway would be constructed to run north around Windsor (i.e. bypass). This refined hybrid is a combination of Draft SEIS Alternatives 4 and 2N and is shown graphically in **Figure 2.3-12**.

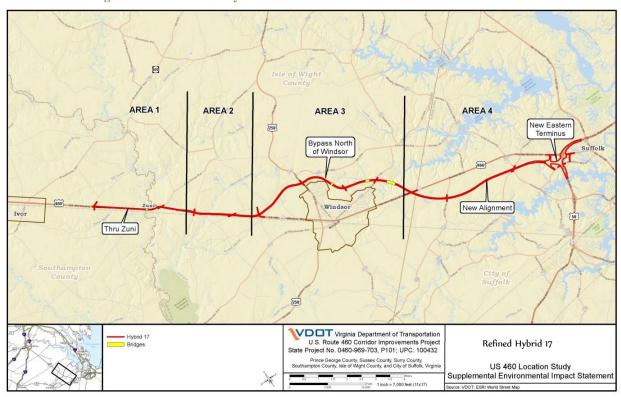


Figure 2.3-11: Refined Hybrid 17 – Between west of Zuni and Eastern Terminus

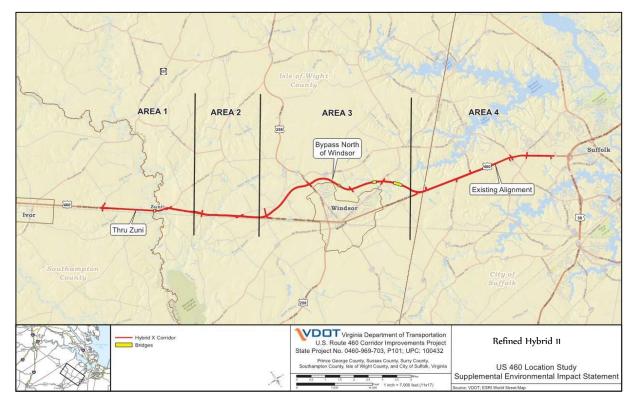


Figure 2.3-12: Refined Hybrid 11 – Between west of Zuni and Eastern Terminus

2.4 REFINED HYBRID COMPARISON

VDOT prepared a technical memorandum that compares the benefits of Refined Hybrid 17 to Refined Hybrid 11 (in the memorandum Refined Hybrid 17 is referenced as Hybrid B and Refined Hybrid 11 is referenced as Hybrid X). This technical memorandum was developed to support FHWA/VDOT's identification of a Preferred Alternative. This memorandum is included in **Appendix A**.

Consistent with the identified key project components, Refined Hybrid 17 and Refined Hybrid 11 were compared based on the following elements from the project Purpose and Need along with wetland impacts, displacements, and project cost:

- Safety crash rates and tendencies; limited access
- Hurricane Evacuation capacity; contraflow potential
- Travel Time and Delay time savings; average speed
- Freight Mobility dedicated truck route capability

The technical memorandum is divided into the following seven sections: 1) Alternatives, 2) Summary Comparison, 3) Traffic Safety, 4) Traffic Operations, 5) Climate Adaptation and Coastal Resiliency, 6) Benefit Cost Analysis, and 7) Assumptions. This analysis presents an evaluation of each option, comparing advantages and disadvantages relative to each refined hybrid's ability to meet Purpose and Need while considering impacts to wetlands, right-of-way (displacements), and project cost.

Table 2.4-1 summarizes the effectiveness of the two refined hybrids, comparing the refined hybrids to the No Build Alternative and Alternative 4 from the Draft SEIS, which represented improving the existing Route 460 alignment. Although choosing Draft SEIS Alternative 4 in Area 4 appeared to not address the key project element of improving the Route 58/Route 460 connection to provide efficient traffic movements to decrease travel time, facilitate increased freight mobility, and better accommodate emergency evacuation, it was included in the assessment to document the degree to which it addressed the key project elements. Alternative 4 was considered to be relatively similar to the No Build Alternative, in that it included no interchange improvements at Route 58. **Appendix B** presents more detailed information for wetland impacts, cost, and displacements by area.

Table 2.4-1: Measures of Effectiveness of No Build Alternative, Draft SEIS Alternative 4, Refined Hybrid 17 and Refined Hybrid 11

| Measure of Effectiveness | No Build Alt. | Draft SEIS Alt. 4 | Refined Hybrid 17 | Refined Hybrid 11 | |
|--|--|--|---|---|--|
| Safety | | | | | |
| Estimated crashes per 100million vehicle miles | 82 | 65 | 50 | 55 | |
| Crash Rate Reduction | 0% | 21% | 41% | 33% | |
| Crashes eliminated per 10,000 annual average | | | | | |
| daily traffic (AADT) over 15 miles of highway in 20 years | 0 | 171 | 326 | 261 | |
| Major through traffic control points | 176 | 107 | 28 | 72 | |
| Limited access facility | No | No | West of Windsor to Route 58 | Around Windsor | |
| Hurri | cane Evacuati | | | | |
| Maximum evacuation capacity (veh/hr) | 4,800 | 5,200 | 13,400 | 5,200 | |
| US Route 58 Interchange capacity (veh/hr) | 4,800 | 4,800 | 12,800 | 4,800 | |
| Contraflow potential | Cannot separate local and regional traffic | Cannot separate local and regional traffic | Can separate local and regional traffic | Cannot separate local and regional traffic (limited by existing interchange) | |
| Trave | Time and Del | ay | | | |
| Corridor travel time savings (hour/year) | 0 | 251,000 | 840,000 | 422,000 | |
| Value of travel time saved (\$million/year) | 0 | \$3.8 | \$12.6 | \$6.3 | |
| Percent travel time savings | 0 | 6% | 16% | 11% | |
| Average speed for corridor (mph) | 43 | 45 | 55 | 50 | |
| Percent increase in corridor speed | 0% | 6% | 29% | 16% | |
| | Freight | | | | |
| Percent truck traffic diverted to new route (East of Windsor to Route 58) | 0% | 0% | 80% to 95% | N/A | |
| Percent truck traffic diverted to new route (West of Windsor to East of Windsor) | 0% | 0% | 70 to 95% | 60% to 95% | |
| New dedicated truck route | No | No | Yes | No | |
| - | Other | | | | |
| Wetland (acres) | 0 | 10 | 52 | 26 | |
| Displacements | 0 | 50 | 22 | 27 | |
| Cost (\$ million) | 0 | 312 | 427 | 338 | |

2.4.1 Benefit Cost Analysis

In addition to the Measures of Effectiveness comparison, presented in **Table 2.4-1**, a Benefit-Cost-Analysis (BCA) conceptual framework was performed to further compare Refined Hybrid 17 and Refined Hybrid 11. This provides a financial measure of project feasibility and offers a basis for comparing two or more alternatives within a single project. Costs incorporated in the BCA included design costs, capital costs, right-of-way costs, environmental mitigation costs, and operating and maintenance costs (O&M) during the analysis period. The basis of the BCA is the incremental difference between the two alternatives. In general, BCA results in two standard metrics where the flow of future benefits and costs are discounted to today's dollars:

- Net Present Value (NPV) = Discounted Benefits Discounted Costs
- Benefit-Cost Ratio (BCR) = Discounted Benefits / Discounted Costs

The specific methodology developed for this analysis is consistent with United States Department of Transportation (USDOT) guidelines and more detail is included in **Appendix A**. A key consideration in structuring the BCA relates to the timing of construction of the improvements.

The capital costs under consideration for the two refined hybrids include: preliminary engineering, construction (including CEI), environmental mitigation, utilities, right-of-way acquisition, and contingency. Potential benefits generated by the Route 460 corridor improvements project include the following benefits that were identified and measured based on the USDOT methodology, described in detail in **Appendix A**.

- Travel Time Savings
- Vehicle Operating Costs
- Benefits to New Users

- Safety Benefits
- Emissions Benefits
- Carbon Dioxide

Table 1 and Table 2 in Attachment A of **Appendix A** summarize benefits and costs within the corridor of Refined Hybrid 17 as compared to Refined Hybrid 11 for proposed alternate build options. Annual costs and benefits are computed and summarized over the life-cycle of the project. Construction of the roadway improvements is expected to take three years, with operations available immediately after completion and continuing for 30 years. Benefits will accrue once the new roadway is fully operational. For purposes of the BCA analysis, construction was assumed to have begun in 2015, with completion by the end of 2017. The selected alternative was assumed to be operational and benefits began accruing in 2018.

The non-discounted total costs of the project are \$338 million for Refined Hybrid 11 and \$427 million for Refined Hybrid 17. This results in an incremental additional capital cost of \$89 million for Refined Hybrid 17 compared to Refined Hybrid 11. The total maintenance cost is estimated to be \$70 million and \$88 million for Refined Hybrid 11 and Refined Hybrid 17, respectively. Due to the maintenance of approximately six additional roadway miles; Refined Hybrid 17 has an incremental additional maintenance cost of approximately \$18 million over the 30 year analysis period. Despite the additional capital cost and estimated cost for maintenance, Refined Hybrid 17 is projected to generate a better benefit to cost ratio because it is anticipated to offer greater benefits than Refined Hybrid 11. Using a seven percent discount rate per USDOT guidelines, the additional investment of capital and maintenance costs associated with Refined Hybrid 17 are expected to result in \$128 million in additional benefits compared to Refined Hybrid 11, generating a benefit to cost ratio of 1.5. At a three percent discount rate, the Refined Hybrid 17 generates \$269 million in benefits and a benefit to cost ratio of 2.8.

2.4.2 Refined Hybrid 17 Evaluation

As a result of the comparative analyses, it was determined that Refined Hybrid 17 is the most effective improvement option for the 16 miles for which the improvements were considered that sufficiently addresses the project's Purpose and Need, while balancing cost, displacements, and wetland impacts VDOT also determined that Hybrid 17 appears to be practicable. As described below, Refined Hybrid 17 yields the lowest corridor crash rate, maximum evacuation capacity, greatest travel time savings, and would be the most effective new route for freight. Unlike Refined Hybrid 11, Refined Hybrid 17 offers an efficient high-speed through connection while maintaining local access. Refined Hybrid 17 also includes a free-flow direct connection from the new highway to existing Route 58. The following metrics compare the 16-mile improvement portions of Refined Hybrid 17 and Refined Hybrid 11:

- Refined Hybrid 17 has the lowest predicted crash rate (49 crashes/100 million vehicle miles), which is 11 percent lower than Refined Hybrid 11 (55 crashes/100 million vehicle miles) and 41 percent lower than the No Build Alternative (82 crashes/100 million vehicle miles).
- Refined Hybrid 17 has 28 traffic conflict points. Refined Hybrid 11 has 72 traffic conflict points. The Refined Hybrid 17 has 61 percent fewer traffic conflict points than Refined Hybrid 11.
- Refined Hybrid 17 provides the greatest evacuation capacity (13,400 vehicles per hour) which is 160 percent higher than Refined Hybrid 11 (5,200 vehicles per hour).
- Refined Hybrid 17 provides the ability to reverse the traffic flow on all four new highway lanes and three of the four lanes on existing Route 460 in an evacuation event. Refined Hybrid 11 provides the ability to reverse only one of the eastbound lanes providing three westbound evacuation lanes in an evacuation event.
- Refined Hybrid 17 improves safety and mobility by separating local and regional traffic. Refined Hybrid 11 does not separate local and regional traffic because all traffic must pass through the existing Route 460/58 interchange.
- Refined Hybrid 17 separates regional traffic away from the Nansemond Suffolk Academy (a pre-K-12 school with approximately 730 students) on Route 460 east of Windsor. The presence of the school creates safety and traffic issues, especially during the hours around the start and end of the school day. The school also includes a speed zone that reduces speeds in the corridor. The presence of the school on Route 460, which includes school bus traffic, is not compatible with the high truck traffic volumes in the corridor. Refined Hybrid 11 does not separate traffic away from the school entrance.
- Refined Hybrid 17 provides a practicable opportunity to divert through truck traffic from existing Route 460 between the western boundary of Town of Windsor and Route 58; Refined Hybrid 11 does not.
- Refined Hybrid 17 provides the greatest annual travel time cost savings (\$12.6M) of any alternative. This annual cost savings is twice as much as Refined Hybrid 11 (\$6.3M).
- Refined Hybrid 17 provides the greatest corridor travel time savings of any alternative with 840,000 hours saved per year. This is twice as much as the 422,000 annual hours saved by Refined Hybrid 11.
- Refined Hybrid 17 separates truck traffic from local traffic and shifts trucks to a facility with lower
 anticipated crash rates. This improves safety because 45 percent of fatal crashes in the Draft SEIS
 study area involved tractor trailers. Refined Hybrid 11 does not separate trucks from the local traffic
 traveling on Route 460 between east of Windsor and Route 58. Separation of trucks from local
 traffic also accommodates improved Freight Mobility.

- Refined Hybrid 17 better addresses the U.S. Department of Transportation (USDOT) initiative to incorporate consideration of climate adaptation and coastal resiliency into their planning processes and investment decisions by providing redundant infrastructure that addresses future environmental risks such as flooding and projected sea-level rise.
- Refined Hybrid 17 provides a coastal risk reduction measure that would improve regional preparedness for evacuation through nonstructural interventions (evacuation planning with redundant infrastructure and elevating Blackwater River Bridge structure).
- Refined Hybrid 17 also contributes to greater system resiliency compared to Refined Hybrid 11, due to the interdependency of its new roadway component's access to the Virginia Ports and the mobility of freight. Refined Hybrid 11's contribution to system resiliency would be less than Hybrid 17 due to a lower Route 58 interchange capacity and lack of a separate alternate route.
- Refined Hybrid 17 has an increased capital cost of \$89 million over Refined Hybrid 11. According to the BCA performed to compare Refined Hybrid 17 and 11, Refined Hybrid 17 is expected to result in \$128 million in additional benefits over Refined Hybrid 11, generating a benefit to cost ratio of 1.5. At a three percent discount rate, Refined Hybrid 17 generates \$269 million in additional benefits and a benefit to cost ratio of 2.8.

2.4.3 Recommended FHWA/VDOT Preferred Alternative

Based on this assessment, VDOT determined that Refined Hybrid 17 has a number of advantages over Refined Hybrid 11 and that it is more effective at addressing the Purpose and Need where the improvements would be made. As a result, Refined Hybrid 17 was identified and selected as FHWA/VDOT's recommended Preferred Alternative. FHWA/VDOT's Preferred Alternative is comprised of the 16 miles of improvements noted above for Refined Hybrid 17 with 36 miles of the No Build Alternative between the western terminus and western Zuni.

On January 5, 2015, VDOT sent a letter, along with the Technical Memorandum comparing Refined Hybrids 11 and 17, to the USACE noting the proposed recommendation and their opinion that their Preferred Alternative appears to be the LEDPA. The USACE replied in a letter dated January 9, 2015, that it did not find reason to disagree with VDOT's assessment that their Preferred Alternative (Refined Hybrid 17) appears to be the LEDPA. However, the letter notes that this does not constitute a final LEDPA determination or an indication of a Section 404 permit decision.

2.5 FHWA/VDOT PREFERRED ALTERNATIVE

2.5.1 Approval of the FHWA/VDOT Preferred Alternative Location

On January 13, 2015, the CTB was presented with FHWA's/VDOT's recommended Preferred Alternative. The CTB passed a resolution on February 18, 2015 approving FHWA's/VDOT's recommended Preferred Alternative and the location for the Route 460 corridor improvements, consistent with the FHWA/VDOT Preferred Alternative presented at the January CTB meeting. The resolution also officially rescinded the CTB's previous 2005 selection of a preferred alternative.

The 2015 recommended FHWA/VDOT Preferred Alternative presented combines a portion of the No Build Alternative with portions of four Build Alternatives from the Draft SEIS (4, 2N, 3, and 1). The FHWA/VDOT Preferred Alternative is a 52-mile corridor between I-295 in Prince George County and Route 58 in Suffolk. **Figure 2.5-1** illustrates the FHWA/VDOT Preferred Alternative compared to the

Build Alternatives from the Draft SEIS. Following is a description of the FHWA/VDOT Preferred Alternative, from west to east:

- from I-295 to approximately one mile west of Zuni the No Build Alternative would be implemented (approximately 36 miles);
- from approximately one mile west of Zuni to two miles west of Windsor (Areas 1 and 2) the existing Route 460 would be upgraded to a four-lane divided highway and include a new bridge across the Blackwater River to eliminate long standing flooding problems (approximately 4 miles); and
- from approximately two miles west of Windsor to the Route 460/58 interchange in Suffolk (Areas 3 and 4), a new four-lane divided highway would be constructed, running north around Windsor, then east of Windsor running south of the existing Route 460 (approximately 12 miles).

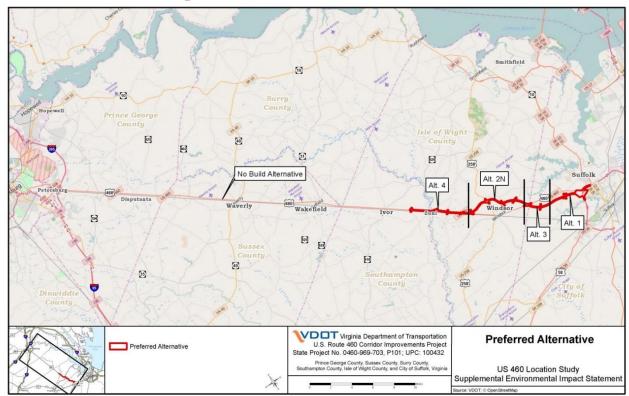


Figure 2.5-1: FHWA/VDOT Preferred Alternative

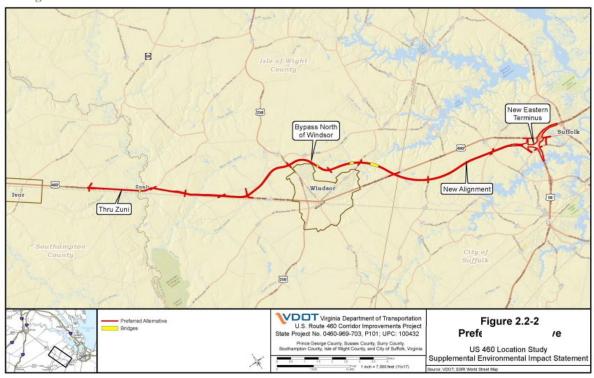
In approving the location of the Preferred Alternative, the CTB recognized the inability to fund the alternatives evaluated in the Draft SEIS in their entirety and acknowledged the Preferred Alternative minimizes wetland impacts while still effectively meeting the overall project purpose.

The summary of wetland impacts, displacements, and cost metrics for the FHWA/VDOT Preferred Alternative are shown in **Table 2.5-1**. The Build portion of the Preferred Alternative is shown in **Figure 2.5-2**. The wetland impacts are based on the data included in the Draft SEIS while the displacements and costs are based on the design refinements discussed in **Section 2.4.2**. Through the development of the Final SEIS and the permit application for the FHWA/VDOT Preferred Alternative, VDOT committed to continuing to work with the federal partners to avoid and minimize impacts to the greatest extent practicable, while addressing the project's Purpose and Need.

| `Metrics | | | | | | |
|-----------------|---------------|----|--------|-----------|--|--|
| Wetland Impacts | Displacements | | Cost | | | |
| | | | Const. | \$287 MIL | | |
| | Residential | 15 | PE | \$25 MIL | | |
| | | | Env. | \$5 MIL | | |
| 52 acres | Commercial | 3 | Util. | \$24 MIL | | |
| | Farming | 3 | RW | \$23 MIL | | |
| | Non-Profit | 1 | Cont. | \$63 MIL | | |
| | Total | 22 | Total | \$427 MIL | | |
| | | | | | | |

Table 2.5-1: FHWA/VDOT Preferred Alternative Metrics

Figure 2.5-2: FHWA/VDOT Preferred Alternative – Between west of Zuni and Eastern Terminus



2.5.2 Further Modifications to the Preferred Alternative

2.5.2.1 Reduction of Property Impacts with an Adjusted Inventory Corridor

The FHWA/VDOT Preferred Alternative combines improvements along the existing Route 460 alignment between west of Zuni and west of Windsor, and along new location bypassing Windsor to the north and crossing existing Route 460 east of Windsor, then traveling south of existing Route 460 to Route 58. The new location portion passes through residential and agricultural properties in part in order to avoid jurisdictional wetland areas, just as some aquatic resources are impacted to minimize effects to properties; these impacts were balanced in working to arrive at a project that is practicable while minimizing impacts to wetlands and streams.

Working with the Virginia Department of Agriculture, VDOT met with impacted property owners and representatives in order to better understand the commercial operation and access needs of the agricultural properties along the 16-mile build portion of the FHWA/VDOT Preferred Alternative and to determine whether it would be feasible to modify the approved location of the alignment in order to reduce property

impacts. Based upon feedback from these meetings, VDOT considered potential inventory corridor adjustments to better balance agricultural and access impacts with impacts to other resources, including wetlands and streams. Following this evaluation, two areas were identified for adjusting the inventory corridor:

- East of Windsor in the vicinity of Old Myrtle Road; and
- East of Route 258 in the vicinity of Deer Path Trail.

Both locations reduced agricultural and commercial operational impacts while still maintaining acceptable project cost and wetland impacts in these areas. Additionally, displacements were reduced and access to these parcels was improved. Inventory corridor Adjustment No. 1 is shown in **Figure 2.5-3** and Inventory Corridor Adjustment No. 2 is shown in **Figure 2.5-4**.

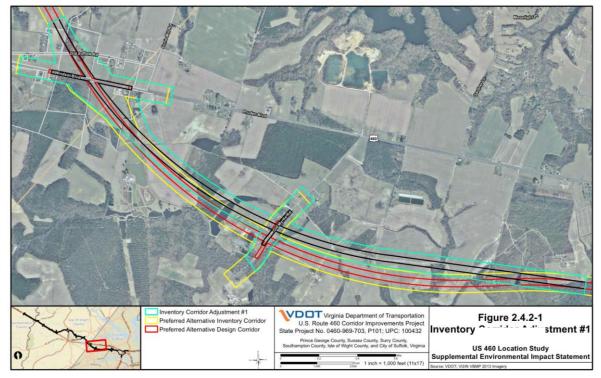


Figure 2.5-3: Inventory Corridor Adjustment No. 1

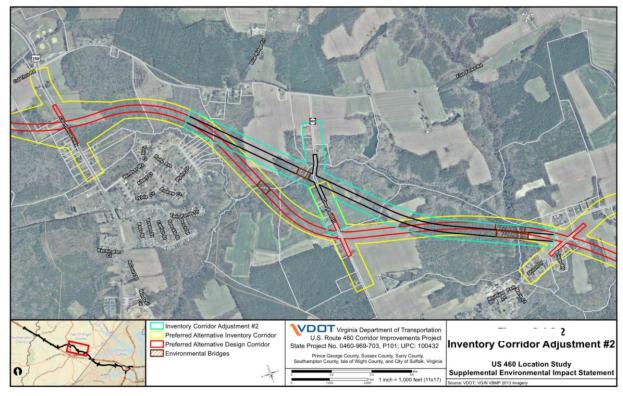


Figure 2.5-4: Inventory Corridor Adjustment No. 2

2.5.2.2 Avoidance and Minimization of Environmental Impacts

The Section 404 permitting process requires that efforts be taken to avoid and minimize impacts to waters of the U.S. to the extent practicable. Impacts were identified by overlaying the FHWA/VDOT Preferred Alternative Design Corridor onto the field delineated boundaries of jurisdictional waters and wetlands along the FHWA/VDOT Preferred Alternative alignment. VDOT then evaluated the merits of modifying the following three design elements in order to avoid and minimize impacts to these resources:

- 1. Horizontal Alignment: A horizontal alignment shift to either avoid or minimize impacts to each wetland group. The bridges along the alignment were adjusted to span wetlands and reduce stream impacts where practicable. Where the bridges spanned wetlands, the abutments and slope protection were located outside the wetland limits.
- 2. Vertical Alignment: Vertical alignment shifts to reduce the impact of roadway fill slopes and in turn minimize wetland impacts.
- 3. Typical Section: A modification to the typical section to reduce wetland impacts based on reducing the section width and increasing the side slope steepness.

As the design was advanced for the FHWA/VDOT Preferred Alternative, opportunities to avoid or minimize impacts to delineated wetlands and streams within the Inventory Corridor were identified and the anticipated LOD was adjusted based on the elements listed above. After a particular avoidance and minimization technique was applied, the resulting wetland and stream impacts were recalculated and compared to the baseline impacts in order to evaluate the degree of the impact reduction, as well as associated changes in construction costs.

Horizontal Alignment Shifts

The first step of the avoidance and minimization methodology was an evaluation of the horizontal alignment of the FHWA/VDOT Preferred Alternative to determine if wetland impacts could be avoided or minimized by an alignment shift. Alignment shifts were evaluated at each wetland location and some wetland locations presented multiple alignment shift opportunities. Alignment shifts that could entirely avoid a wetland area were preferred and considered first, followed by alignment shifts that minimized impacts to the delineated wetland areas. Bridge lengths along the shifted alignments were adjusted to reduce wetland and stream impacts where practicable.

Vertical Alignment (Profile) Adjustments

The second step of the avoidance and minimization methodology was an evaluation of the vertical alignment of the FHWA/VDOT Preferred Alternative. The difference between the height of the proposed roadway and the existing ground can have a significant influence on the width of disturbance for the proposed roadway. Lowering the profile and reducing the height above existing ground can significantly narrow the side slope limits and resulting direct effect on impacts to wetlands. Because the delineated wetland areas are low-lying areas and are prone to flooding during large storm events, the engineering team evaluated opportunities to lower the proposed vertical profile for the roadway in an attempt to reduce wetland impacts while balancing any vertical alignment adjustments against drainage design requirements.

Typical Section Modifications

The third step of the avoidance and minimization methodology was evaluating modifications to the typical section that would reduce the width of improvements and, in turn, reduce wetland impacts. Seven typical sections were generated in accordance with VDOT design standards, and used to evaluate reductions in wetland impacts. Modifications to the typical sections included the use of guardrail at the outside shoulder to reduce clear zone requirements, retaining walls at the edge of shoulders to reduce the side slope footprint, and median barriers to reduce the median width. The construction costs, reduction in impacts, and practicality of each typical section modification were analyzed for each wetlands group. A preferred typical section was then identified for each wetland group, and this section was used to calculate the anticipated wetland impact area and anticipated construction costs.

Typical Section C from the Draft SEIS was used for the area through Zuni because it provided the smallest footprint. Typical Section A from the Draft SEIS was used for the remainder of the corridor; however, modifications were made to reduce impacts to wetlands where feasible. As a result, seven new typical sections (A1 through A7) were generated to apply combinations of guardrails, retaining walls, and median barriers along the FHWA/VDOT Preferred Alternative alignment. All of the new typical sections are consistent with the Department's current Geometric Design Standard for a Rural Principal Arterial System (GS-1) with a 75 mph design speed. Typical Section C has a 45 mph design speed. Following are descriptions of each of the typical sections considered and a graphic illustrating each section.

Typical Section A1

This typical section represents the roadway section anticipated for the majority of areas where fill heights are relatively low and will not create an excessively large side slope footprint. This section is consistent with the Department's current Geometric Design Standard for a Rural Principal Arterial System (GS-1) with a 75 MPH design speed. The minimum section width for the application of this typical section is 162 feet based on meeting minimum clear zone requirements.

The fixed width of this typical section equals 120 feet and is shown in **Figure 2.5-5**. It includes the following features:

- Two 12-foot travel lanes in each direction (total = 48 feet);
- Depressed median including the eight-foot graded (four feet paved) shoulder in each direction (total = 46 feet); and
- A 13-foot graded outside shoulder (eight feet paved) in each direction (total = 26 feet).

The minimum variable width of this typical section equals 42 feet. It includes the following features:

- Outside graded area on each side at 6:1 slope (21 feet wide) as the remaining recoverable area, in addition to the shoulder area, to provide the required 34 feet clear zone (total = 42 feet); and
- Variable width graded area with a slope between 2:1 and 6:1 to tie the proposed grading to the existing ground. The slope depends on the fill height and is determined using VDOT Road and Bridge Standards CS-4, Typical Methods of Grading Side Slopes.

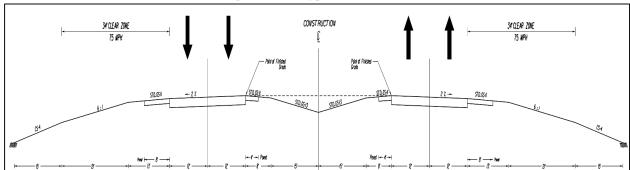


Figure 2.5-5: Typical Section A1

Typical Section A2

This typical section represents the roadway section anticipated for the majority of areas where fill heights are relatively high and/or the intent is to further minimize the section's footprint as compared to Typical Section A. This section is consistent with the Department's current Geometric Design Standard for a Rural Principal Arterial System (GS-1) with a 75 MPH Design Speed. The minimum section width for the application of this typical section is 134 feet.

The fixed width of this typical section equals 120 feet and is shown in **Figure 2.5-6**. It includes the following features:

- Two 12-foot travel lanes in each direction (total = 48 feet);
- Depressed median including the eight-foot graded (four feet paved) shoulder in each direction (total = 46 feet);
- A 10-foot paved outside shoulder in each direction (total = 20 feet); and
- A three-foot graded area with guardrail in each direction (total = 6 feet).

The minimum variable width of this typical section equals 14 feet based on an assumed fill height of 4.6 feet. It includes the following features:

• Variable width graded area behind the guardrail on each side with a 2:1 slope to tie the proposed grading to the existing ground.

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Figure 2.5-6: Typical Section A2

Typical Section A3

This typical section represents the roadway section anticipated for areas where fill heights are relatively high and/or the intent is to achieve the minimum sectional footprint while maintaining a depressed median. This section is consistent with the Department's current Geometric Design Standard for a Rural Principal Arterial System (GS-1) with a 75 MPH Design Speed. The section width for the application of this typical section is fixed at 118 feet due to vertical walls being included to the outside of the travel way.

The fixed width of this typical section equals 118 feet and is shown in **Figure 2.5-7**. It includes the following features:

- Two 12-foot travel lanes in each direction (total = 48 feet);
- Depressed median including the eight-foot graded (four feet paved) shoulder in each direction (total = 46 feet);
- A 10-foot paved outside shoulder in each direction (total = 20 feet); and
- A rigid concrete barrier and retaining wall in each direction (total = 4 feet). The walls will be either mechanically stabilized earth or concrete retaining, depending on the wall height and other cost considerations.

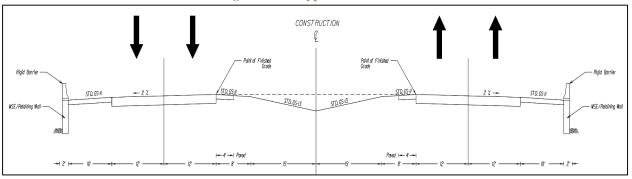


Figure 2.5-7: Typical Section A3

Typical Section A4

This typical section represents the roadway section anticipated for areas where fill heights are relatively low and/or the intent is to further minimize the section's footprint as compared to Typical Section A. This section is consistent with the Department's current Geometric Design Standard for a Rural Principal Arterial System (GS-1) with a 75 MPH Design Speed. The minimum section width for the application of this typical section is 138 feet, based on meeting minimum clear zone requirements.

The fixed width of this typical section equals 96 feet and is shown in **Figure 2.5-8**. It includes the following features:

- Two 12-foot travel lanes in each direction (total = 48 feet);
- One concrete median barrier (two feet wide) with two 10-foot paved shoulders to separate the opposing mainline lanes of traffic (total = 22 feet); and
- A 13-foot outside graded shoulder (eight feet paved) in each direction (total = 26 feet).

The minimum variable width of this typical section equals 42 feet. It includes the following features:

- Outside graded area on each side at 6:1 slope (21 feet wide) as the remaining recoverable area, in addition to the shoulder area, to provide the required 34 feet clear zone; and
- Variable width graded area with a slope between 2:1 and 6:1 to tie the proposed grading to the existing ground. The slope depends on the fill height and is determined using VDOT Road and Bridge Standards CS-4, Typical Methods of Grading Side Slopes.

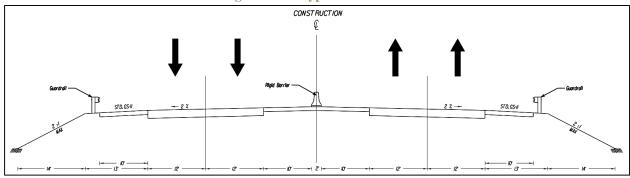


Figure 2.5-8: Typical Section A4

Typical Section A5

This typical section represents the roadway section anticipated for areas where fill heights are relatively high and/or the intent is to further minimize the section's footprint as compared to Typical Section B. This section is consistent with the Department's current Geometric Design Standard for a Rural Principal Arterial System (GS-1) with a 75 MPH Design Speed. The minimum section width for the application of this typical section is 110 feet.

The fixed width of this typical section equals 96 feet and is shown in **Figure 2.5-9**. It includes the following features:

- Two 12-foot travel lanes in each direction (total = 48 feet);
- One concrete median barrier (two feet wide) with two 10-foot paved shoulders to separate the opposing mainline lanes of traffic (total = 22 feet);
- A 10-foot paved outside shoulder in each direction (total = 20 feet); and
- A three-foot graded area with guardrail in each direction (total = 6 feet).

The minimum variable width of this typical section equals 14 feet, based on an assumed fill height of 4.6 feet. It includes the following features:

• Variable width graded area behind the guardrail on each side with a 2:1 slope to tie the proposed grading to the existing ground.

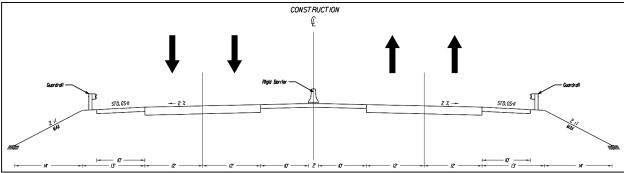


Figure 2.5-9: Typical Section A5

Typical Section A6

This typical section represents the roadway section anticipated for areas where fill heights are relatively high and/or the intent is to achieve the minimum sectional footprint while providing a divided facility. This section is consistent with the Department's current Geometric Design Standard for a Rural Principal Arterial System (GS-1) with a 75 MPH Design Speed. The section width for the application of this typical section is fixed at 94 feet due to vertical walls being included to the outside of the travel way.

The fixed width of this typical section equals 94 feet and is shown in **Figure 2.5-10**. It includes the following features:

- Two 12-foot travel lanes in each direction (total = 48 feet);
- Two 10-foot paved inside shoulders with one center concrete median barrier (two feet wide) to separate the opposing mainline lanes of traffic (total = 22 feet);
- A 10-foot paved outside shoulder in each direction (total = 20 feet); and
- A rigid concrete barrier and retaining wall in each direction (total = 4 feet). The walls will be either
 mechanically stabilized earth or concrete retaining walls, depending on the wall height and other
 cost considerations.

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Figure 2.5-10: Typical Section A6

Typical Section A7

This typical section represents the roadway section evaluated for the project area east of Zuni. This section is consistent with the Department's current Geometric Design Standard for an Urban Principal Arterial System (GS-5) with a 60 MPH Design Speed. The minimum section width for the application of this typical section is 106 feet.

The fixed width of this typical section equals 92 feet and is shown in **Figure 2.5-11**. It includes the following features:

- One 12-foot travel lane and one 13-foot travel lane in each direction (total = 50 feet);
- One 16-foot continuous two-way median left turn lane (total = 16 feet);
- A 10-foot paved outside shoulder in each direction (total = 20 feet); and
- A three-foot graded outside area with guardrail in each direction (total = 6 feet).

The minimum variable width of this typical section equals 14 feet, based on an assumed fill height of 4.6 feet. It includes the following features:

• Variable width graded area behind the guardrail on each side with a 2:1 slope to tie the proposed grading to the existing ground.

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Figure 2.5-11: Typical Section A7

The Preferred Alternative with the locations of the applied avoidance and minimization typical sections is illustrated in **Figure 2.5-12**.

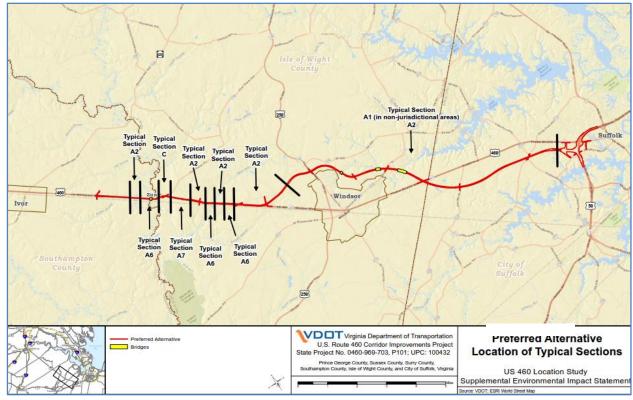


Figure 2.5-12: Preferred Alternative Location of Typical Sections

2.5.2.3 Operational Considerations

To better understand the impacts, benefits, and costs of alternative designs for intersecting roadways including side road crossings as well as interchanges and intersections, VDOT performed a traffic operational analysis. More detail regarding the traffic flow and operations can be found in the *Supplemental Transportation and Traffic Technical Report* (VDOT, 2016h).

The evaluation of side roads determined that having the new Route 460 cross over the side roads, as compared to the side roads crossing over the new Route 460 (as presented in the Draft SEIS) would provide the least environmental and side road access impacts for a similar project cost. This approach also yielded fewer property displacements.

Additionally, at-grade intersections and grade separated interchanges were evaluated at four locations, comparing access options, potential wetland impacts, stream impacts, traffic operations, and costs. The following sections describe the various project elements (interchanges, intersections, bridges structures, etc.) specific to the Preferred Alternative and the design considerations that most significantly influenced the configuration of Preferred Alternative.

2.5.2.4 Potential Interchange Locations

The following three interchanges were evaluated, comparing access options, potential wetland impacts, stream impacts, level of service, and costs. An analysis of options at these three locations was conducted to identify operational improvements that would provide cost-effective benefits with the least impacts. The result of these analyses identified the following elements to be included as part of the FHWA/VDOT Preferred Alternative:

- Route 460 overpass of Route 258 with no interchange.
- Route 460/existing Route 460 Interchange on the east side of Windsor full diamond interchange with a loop ramp.
- Route 460/Route 58 Eastern Terminus full directional interchange with access from new route 460 to Route 58.

These locations are important connections along the corridor in order to meet Purpose and Need requirements such as improved safety, economic development, freight mobility, and reduced travel time. While the Route 58/Route 460 connection (eastern terminus of the project) must be a grade separated interchange facility to accommodate the daily traffic at an efficient and safe level of service, the Route 460 crossings with existing Route 460 on the east side of Windsor and existing Route 258 were evaluated for both at-grade and grade separated solutions. The options evaluated for each location included the following key metrics:

- Project cost
- Wetland impacts
- Stream impacts
- Operation Level of Service (LOS)

Route 460/Route 258

The Route 460/Route 258 crossing on the east side of Windsor is located approximately five miles west of the existing Route 460 crossing along the Northern Bypass of Windsor and represents another potential point of access from Route 460 to Windsor. Since the majority of the existing wetlands in the vicinity of this connection are located in the northwest, southwest and southeast quadrants of the location of this crossing, providing grade separated access while avoiding impacts to jurisdictional wetland areas is difficult. In order to determine an appropriate crossing improvement, the following four options were evaluated:

- Full single-point diamond interchange (SPDI)
- Partial SPDI
- At-grade intersection
- Route 460 crossing over existing Route 258 without access

Full SPDI. A full SPDI provides the best opportunity for grade separated access to all movements from Route 460 to Route 258. This interchange configuration utilizes the smallest footprint to minimize impacts to jurisdictional wetland areas and properties. As shown in **Table 2.5-2** below, the operational analysis yielded satisfactory results for the anticipated 2040 design year traffic volumes and cost and wetland impacts were greater than the other options. The proposed Full SPDI configuration, along with the roadway typical sections for improved Route 258 and new Route 460, is shown in **Figure 2.5-13**.

Partial SPDI. Although a partial SPDI does not offer grade separated access to all movements from Route 460 to Route 258, the traffic analysis revealed that the eastbound Route 460 to Route 258 and Route 258 to westbound Route 460 movements are not necessary to maintain a satisfactory LOS. Since removing these movements from the interchange also reduces the footprint and corresponding wetland impacts and properties, this interchange configuration offers the operational benefits of grade separated access at a lower cost than the full SPDI. However, as shown in **Table 2.5-2** below, the partial SPDI costs over \$18 million more than the Route 258 crossing and at-grade intersection options without substantially improving the

operational efficiency. The proposed Partial SPDI configuration, along with the roadway typical sections for improved Route 258 and new Route 460, is shown in **Figure 2.5-14.**

At-grade intersection. An at-grade intersection provides access to all traffic movements from Route 460 to Route 258 with the lowest cost and smallest impacts to jurisdictional wetland areas and adjacent properties. However, even with proposed improvements along Route 258, including an additional travel lane and left turn lane in both directions, the traffic analysis revealed that the anticipated traffic LOS in 2040 is unsatisfactory to poor. The proposed at-grade intersection configuration, along with the roadway typical sections for improved Route 258 and new Route 460, is shown in **Figure 2.5-15.**

Route 460 crossing Over Route 258 with No Interchange. Based on the traffic operational analysis, a lack of access at the proposed Route 460 and Route 258 crossing will not cause the anticipated LOS on the surrounding existing streets to be unsatisfactory before 2040. Local traffic can access the new Route 460 using the existing Route 460 intersection to the west side of Windsor. This configuration has the lowest cost, impacts to jurisdictional wetland areas, and property impacts of the options considered. The proposed Route 460 crossing configuration, along with the roadway typical sections for new Route 460, is shown in Figure 2.5-16.

Based on the results shown in **Table 2.5-2** and summarized above, the **Route 460 crossing over Route 258** with no interchange was selected as the Preferred Alternative's improvement for the Route 258 crossing. Since the lack of access between Route 258 and Route 460 will not cause an unsatisfactory LOS on the surrounding existing streets in 2040, this configuration's cost, impacts to jurisdictional wetland areas, and property impacts are preferred.

Table 2.5-2: Route 460/Route 258 Intersection and Interchange Configuration Comparison Matrix

| Option No. | Description ^{1, 2} | Project Cost ³ (\$ M) | Estimated Stream Impacts (LF) | Estimated Wetland Impacts (Ac) | LOS ⁴ |
|---------------|-----------------------------------|--|-------------------------------|---|------------------|
| - | Draft SEIS Design Corridor | \$427 | 13,624 | 52.0 | - |
| 1 | 258 intersection/460 intersection | \$428 | 9,497 | 50.1 | D (E)/C (D) |
| 2 | 258 intersection/460 interchange | \$448 | 9,605 | 50.5 | D (E)/C (C) |
| 3 | 258 Full SPDI/460 intersection | \$457 | 9,603 | 50.9 | C (C)/C (D) |
| 4 | 258 Full SPDI/460 interchange | \$478 | 9,711 | 51.4 | C (C)/C (C) |
| 5 | 258 Partial SPDI/460 intersection | \$449 | 9,603 | 49.5 | C (C)/C (D) |
| 6 | 258 Partial SPDI/460 interchange | \$470 | 9,711 | 49.9 | C (C)/C (C) |
| 7 | 258 overpass/460 intersection | \$431 | 9,497 | 48.2 | A (A)/C (D) |
| 8 | 258 overpass/460 interchange | \$451 | 9,605 | 48.6 | A (A)/C (C) |

 $[\]overline{}$ The Draft SEIS Design Corridor project cost and stream and wetland impacts are based on the design corridor associated with the Preferred Alternative adopted by the CTB on February 18, 2015.

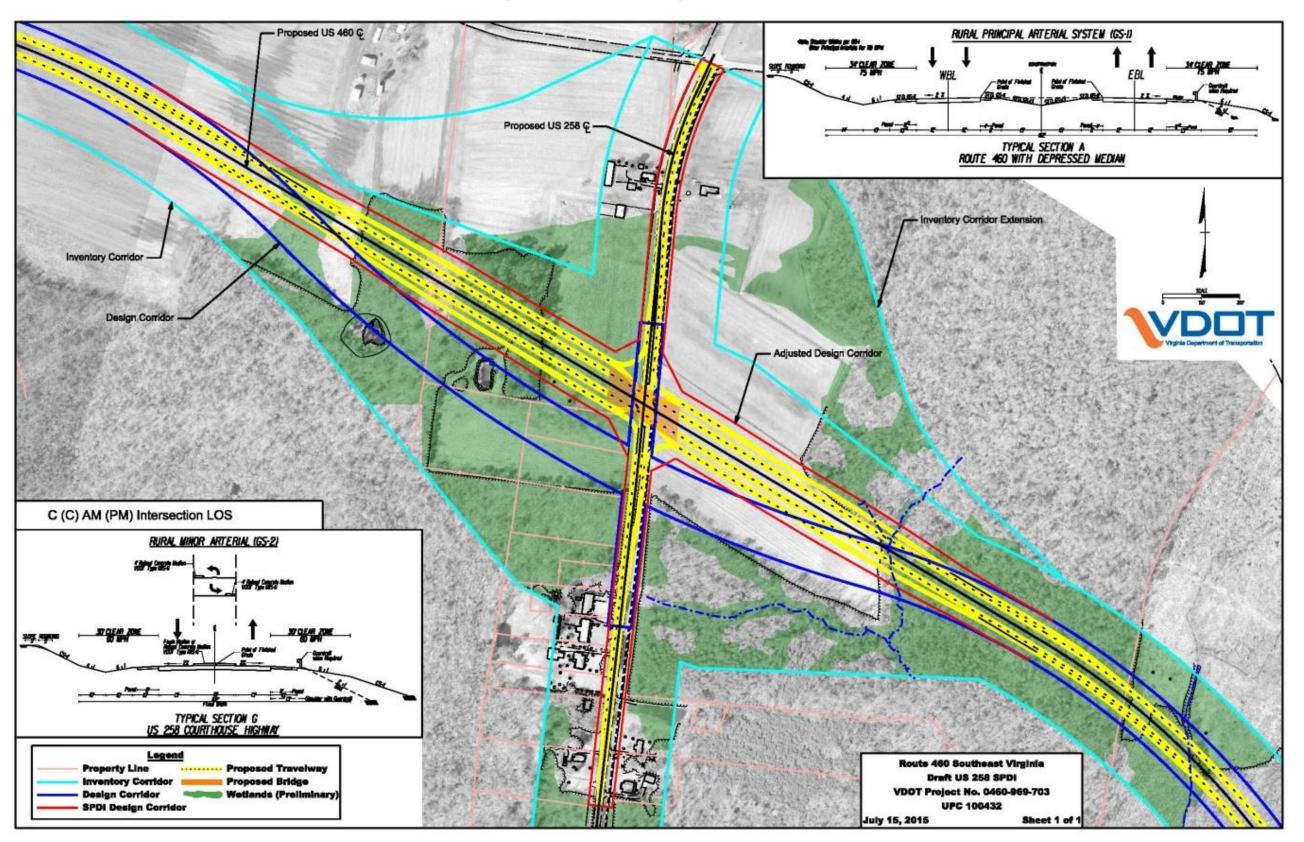
² The project cost and stream and wetland impacts for Options 1 through 8 are based on the estimated preliminary construction limits within the field delineated streams and wetlands.

³ The project cost includes estimated amounts for raw construction, CEI, mobilization, engineering, utility relocation, right-of-way acquisition, environmental mitigation, and contingency.

⁴ AM (PM) 2040 LOS.

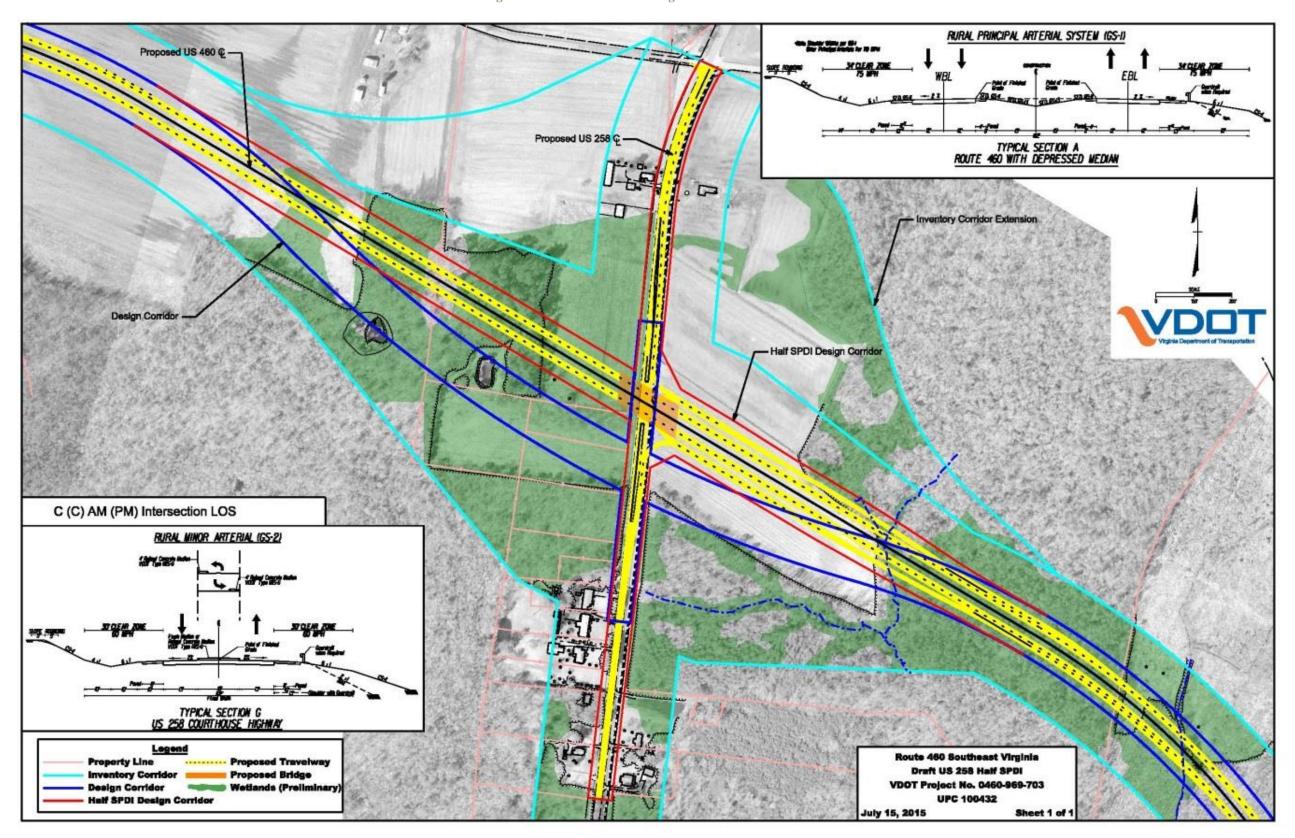
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Figure 2.5-13: Route 460/Existing Route 258 Full SPDI



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Figure 2.5-14: Route 460/Existing Route 258 Partial SPDI



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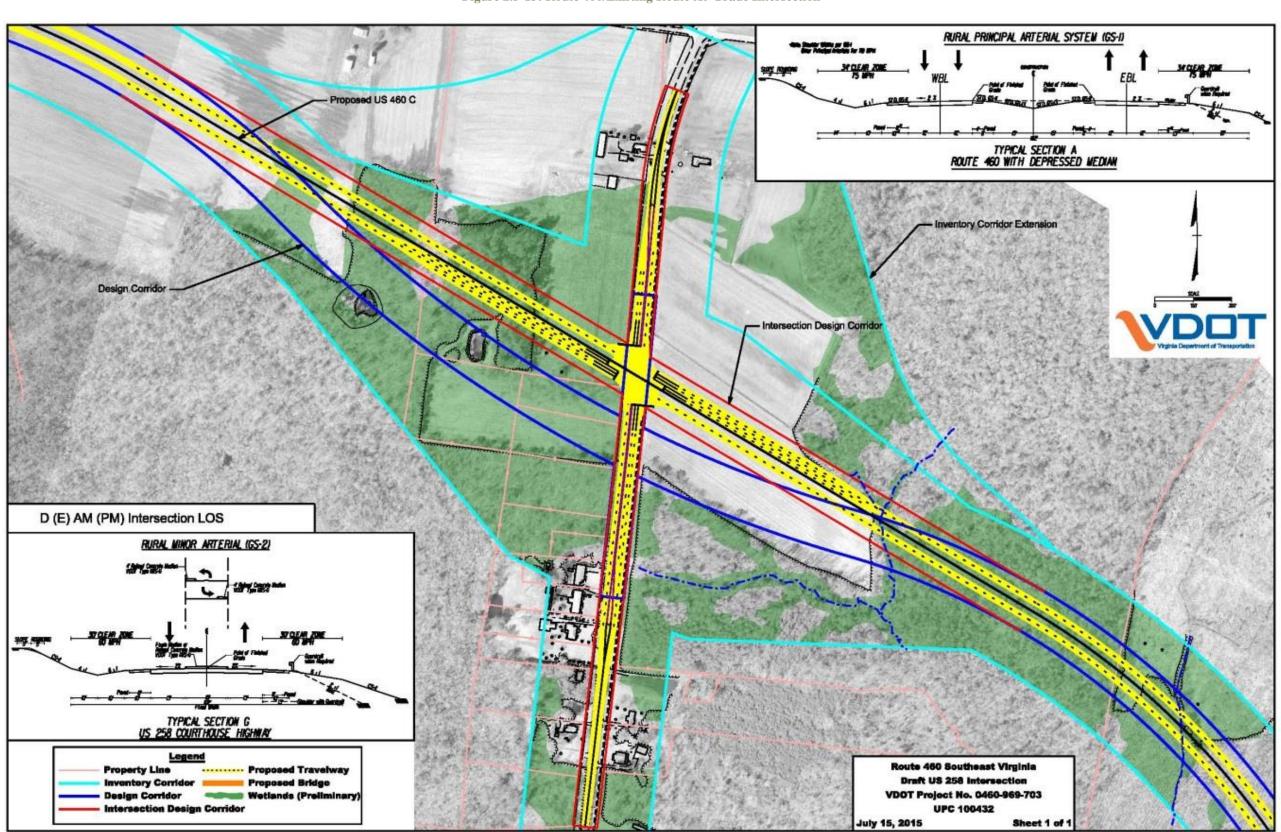
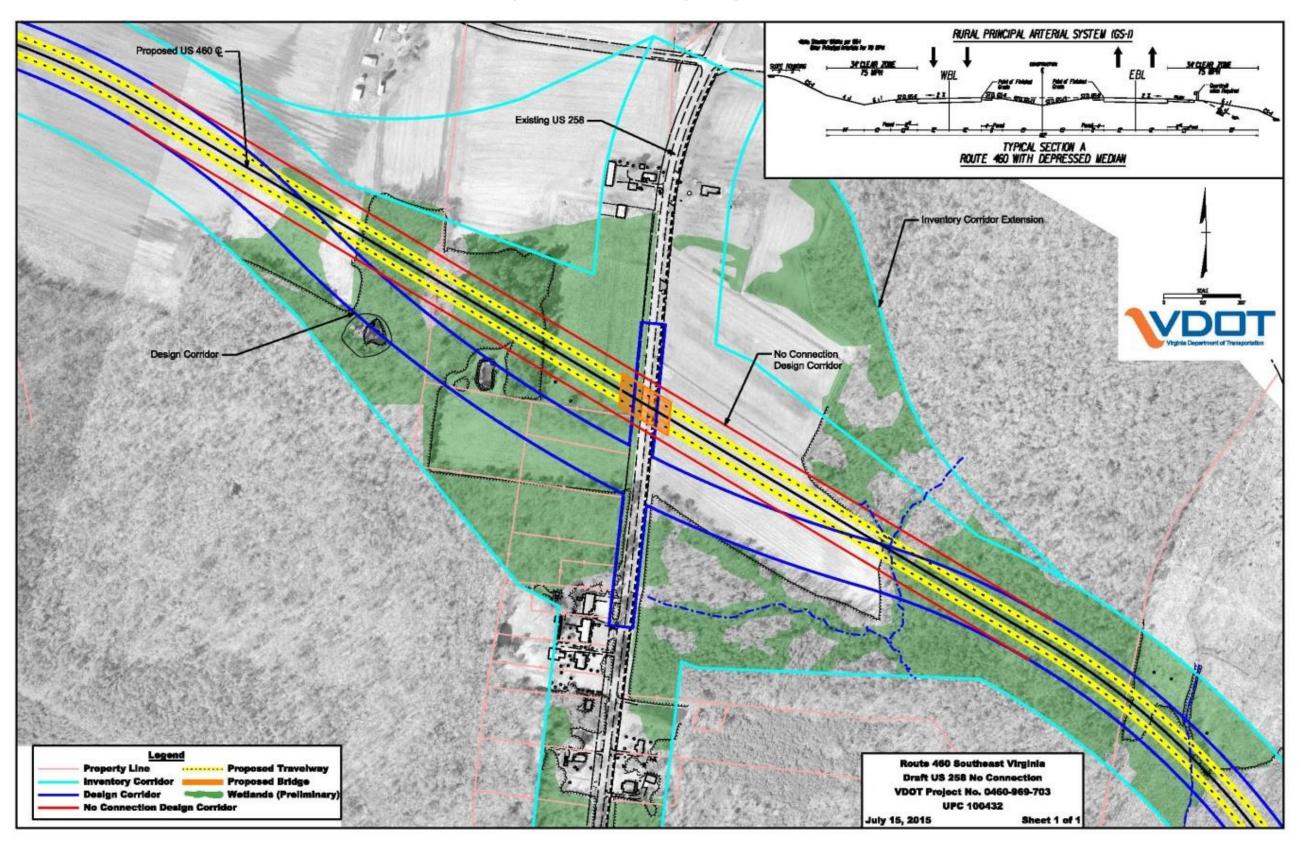


Figure 2.5-15: Route 460/Existing Route At-Grade Intersection

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Figure 2.5-16: Route 460 crossing Existing Route 258



New Route 460/Existing Route 460 East of Windsor

The new Route 460/existing Route 460 crossing on the east side of Windsor is located approximately five miles west of Route 58 and represents a potential point of access from Route 460 to downtown Windsor. Since the majority of the existing wetlands in the vicinity of this connection are located in the southeast quadrant of the crossing, a diamond interchange with a loop ramp in the southwest quadrant offers the best opportunity for grade separated access while minimizing the impacts to jurisdictional wetland areas and properties. While other grade separated configurations were considered, such as a Single Point Diamond Interchange (SPDI), the additional cost combined with a smaller footprint did not reduce the impacts to wetlands and streams at this location. The proposed Diamond Interchange configuration, along with the roadway typical sections for existing and new Route 460, is shown in **Figure 2.5-17**.

Along with the diamond interchange, an at-grade intersection configuration was also evaluated. While property impacts, right-of-way acquisition, and cost are greatly reduced with an intersection, impacts to jurisdictional areas were similar and operational LOS was less efficient. The interchange accommodates access to and from the existing and planned expansion of the industrial area (including the Shirley T. Holland Intermodal Park) located south of town as well as the Town of Windsor via existing Route 460. The proposed intersection configuration, along with the roadway typical sections for existing and new Route 460, is shown in **Figure 2.5-18.**

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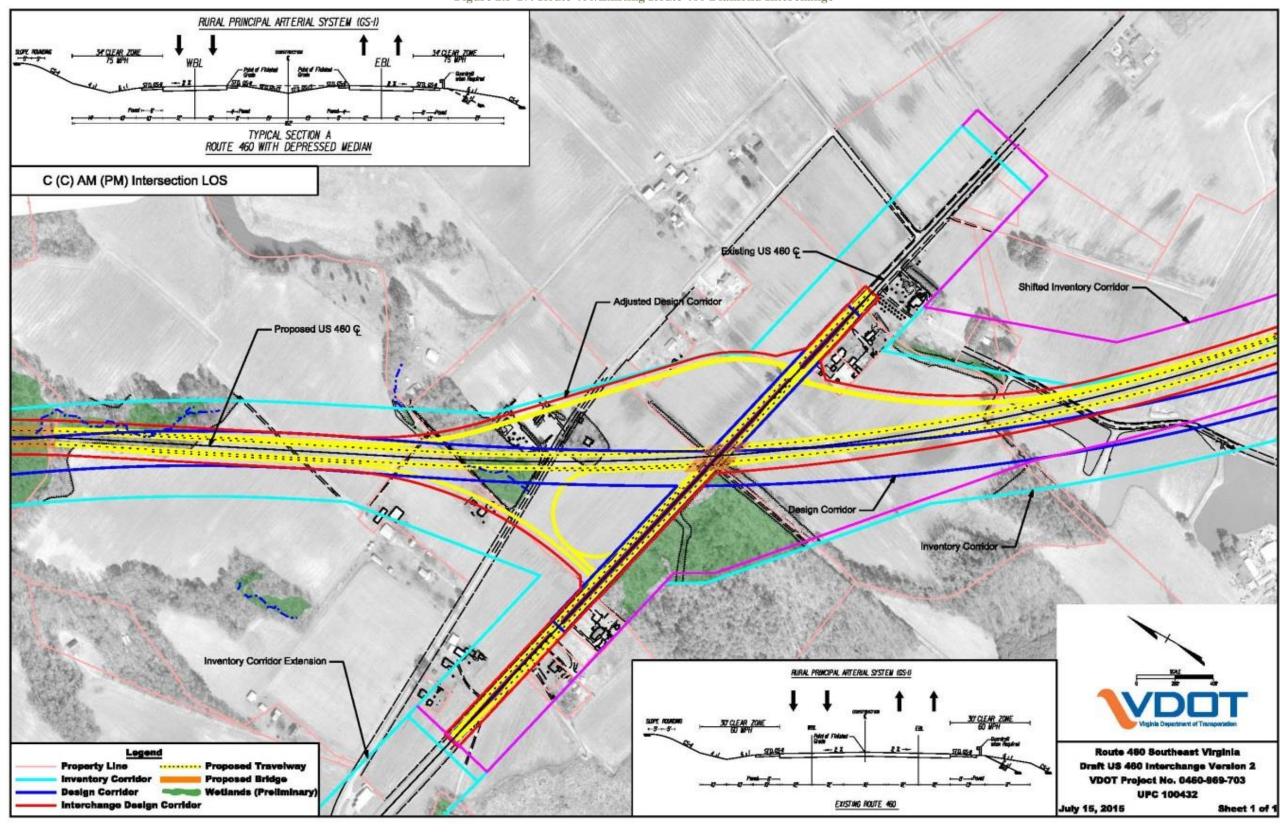
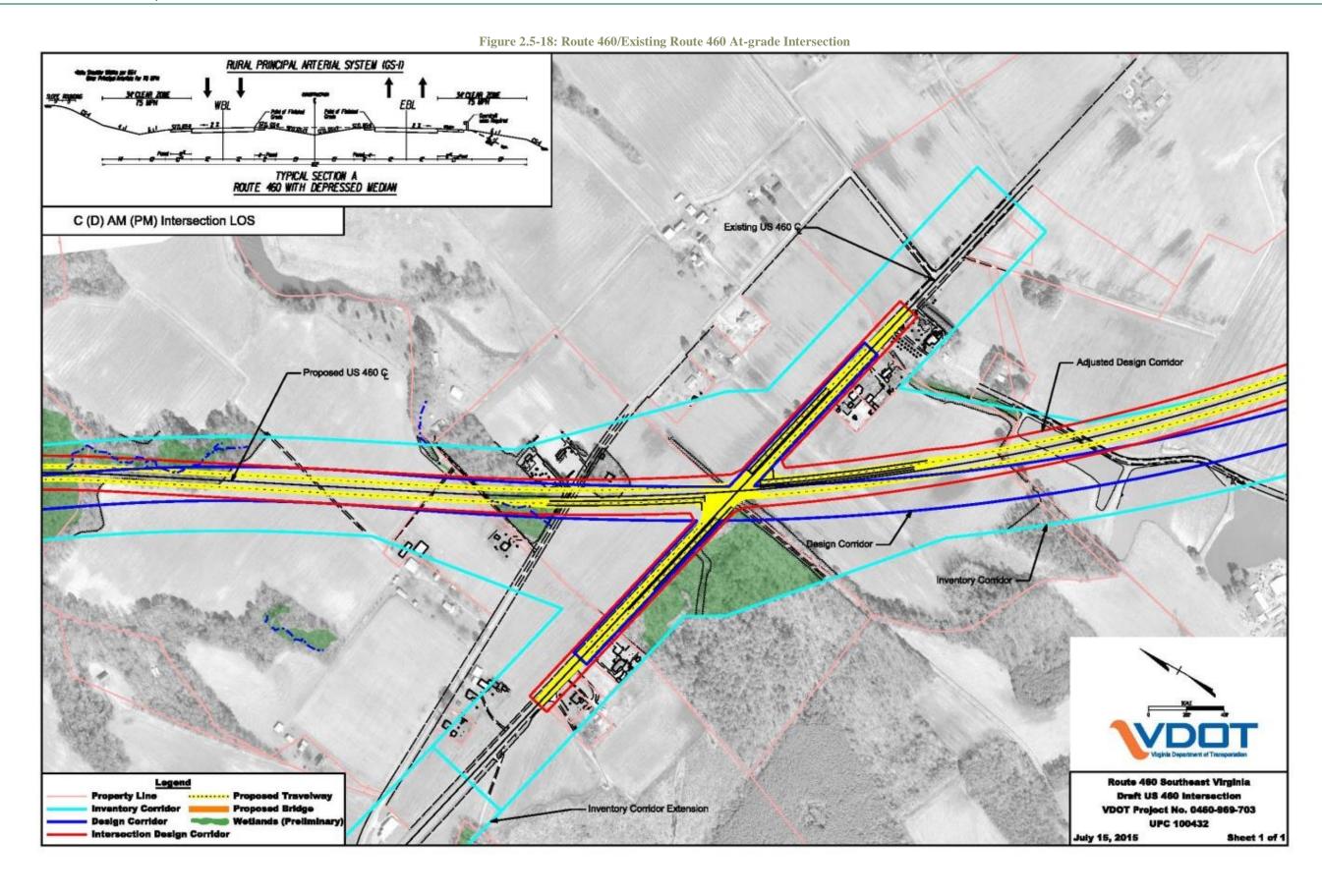


Figure 2.5-17: Route 460/Existing Route 460 Diamond Interchange

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Route 460/Route 58 - Eastern Terminus

The Preferred Alternative includes an interchange with Route 58, which provides a connection of the proposed Route 460 travel lanes to Route 58 (eastbound and westbound) and to existing Route 460 and General Early Drive. Additionally, the interchange improvements include ramp modifications to improve traffic flow from Route 58 to existing Route 460 and from existing Route 460 to Route 58. East of Route 58, a local road will be provided to connect Murphy's Mill Road with existing Route 460.

The following five interchange configurations were evaluated in an effort to identify the best solution for the Eastern Terminus:

- 1. Full Directional access from new Route 460 to existing Route 58
- 2. Traditional Trumpet design
- 3. Modified Trumpet design
- 4. Modified Full Directional design with eastbound (EB) Route 58 to westbound (WB) Route 460 loop
- 5. Modified Trumpet design where Route 460 is the predominant roadway through the interchange

These interchange options were evaluated based on construction and project costs, and wetland and stream impacts. Using this process, the following two interchange configurations were eliminated from further consideration:

- 2. **Traditional Trumpet design**. This configuration would have greater costs and larger wetland and stream impacts than Option No. 3 *Modified Trumpet* design, without providing any measurable operational benefits.
- 4. **Modified Full Directional design with EB Route 58 to WB Route 460 loop**. This configuration would have similar costs and larger wetland and stream impacts than Option No. 1 *Full Directional* access design, without providing any measurable operational benefits.

The three remaining options were analyzed further for traffic operational efficiency:

- 1. **Full Directional access design**. This configuration would provide access from new Route 460 to Route 58 using primarily flyover ramps. Partial access would be provided to Route 460 from relocated General Early Drive. A new Murphy's Mill Connector would provide access to existing Route 460. This option would have the largest costs, but smallest wetland and stream impacts. This option also would have the best operational efficiency. While the raw construction cost would be more that \$34 million greater than Option 3 and Option 5, the operational efficiency would provide a safer roadway with the best opportunity for improved freight mobility and hurricane evacuation. The proposed Option No. 1 interchange configuration, along with the proposed typical sections and associated local road improvements, is shown in **Figure 2.5-19**.
- 3. **Modified Trumpet design**. This option would improve safety and operations by further increasing distance between EB Route 58 access points from existing Route 460 and new Route 460. Full access would be provided to Route 460 from relocated General Early Drive. A new Murphy's Mill connector would be provided for access to existing Route 460. This option would have the smallest costs but largest wetland and stream impacts. This option also would have good operational efficiency. Although the raw construction cost would be the least of the three options, the wetland and stream impacts would be substantially greater than Option No. 5 and more than double Option No. 1. Furthermore, since the operational efficiency would be similar to Option No. 5, but less

- than Option No. 1, freight mobility and hurricane evacuation improvements are not as desirable. The proposed Option No. 3 interchange configuration, along with the proposed typical sections and associated local road improvements, is shown in **Figure 2.5-20**.
- 5. Modified Trumpet design where Route 460 is the predominate roadway through the interchange. This option also would improve safety and operation by further increasing distance between EB Route 58 access points from existing Route 460 and new Route 460. Full access would be provided to Route 460 from relocated General Early Drive. A new Murphy's Mill connector road would provide access to existing Route 460. This option also would have good operational efficiency. Although the raw construction cost would be \$4 million more than option 3, the wetland and stream impacts would be substantially less than Option No. 3, but still an additional acre of wetland impacts and over 300 additional feet of stream impacts than Option No. 1. Furthermore, since the operational efficiency would be similar to Option No. 3, but less than Option No. 1, freight mobility and hurricane evacuation improvements would not be as desirable. The proposed Option No. 5 interchange configuration, along with the proposed typical sections and associated local road improvements, is shown in Figure 2. 5-21.

More detail regarding the traffic flow and operations can be found in the *Final SEIS Supplemental Transportation and Traffic Technical Report* (VDOT, 2016h). **Table 2.5-3** summarizes the results of the evaluation of the five interchange options. Following careful consideration, **Option** No. 1 was selected as the Preferred Alternative's Eastern Terminus configuration. While this option has the largest costs, it has the smallest wetland and stream impacts and best operational efficiency of the interchnage configrations considered.

Table 2.5-3: Eastern Terminus Configuration Comparison Matrix

| Eastern | | Cos | st | Estimated Stream | Estimated Wetland | |
|-------------------------------------|---|-------------------------------------|----------------------------------|---------------------------|---------------------------|--|
| Terminus Option | Description | Raw Construction (\$ Million) | Total Project (\$ Million) | Impacts (LF) ¹ | Impacts (Ac) ¹ | |
| Draft SEIS ET Design Corridor | Full Directional access from new Route 460 to Route 58 using flyover ramps; partial access from relocated General Early Drive to new Route 460 | \$78 | \$133 | 1,340 | 5.2 | |
| Final SEIS Option #1 | Full Directional access from new Route 460 to Route 58 using flyover ramps; partial access from relocated General Early Drive to new Route 460 | \$77 | \$131 | 131 | 3.1 | |
| Final SEIS Option #2 | Trumpet design improves safety and operation by increasing distance between EB Route 58 access points from existing Route 460 and new Route 460; provides full access from relocated General Early Drive to new Route 460 | \$47 | \$80 | 1,719 | 7.4 | |

| Eastern | | Cos | st | Estimated Stream | Estimated Wetland | |
|-------------------------|--|-------------------------------------|----------------------------------|------------------------------|---------------------------|--|
| Terminus Option | Description | Raw Construction (\$ Million) | Total Project (\$ Million) | Impacts (LF) ¹ | Impacts (Ac) ¹ | |
| Final SEIS Option #3 | Modified Trumpet design improves safety and operation by further increasing distance between EB Route 58 access points from existing Route 460 and new Route 460; provides full access from relocated General Early Drive to new Route 460 | \$39 | \$66 | 584 | 7.3 | |
| Final SEIS Option #4 | Modified Full Directional design with EB Route 58 to WB Route 460 loop; maintains existing Murphy's Mill Road across Route 58; provides partial access from relocated General Early Drive to new Route 460 | \$74 (\$65) ² | \$126 (\$110) ² | 351 (351) ² | 3.4 (3.0) ² | |
| Final SEIS Option #5 | Modified Trumpet design where Route 460 is the predominant roadway through the interchange; provides full access from relocated General Early Drive to new Route 460 | \$43 (\$30) ² | \$73 (\$51) ² | 474 (174) ² | 4.1 (3.6) ² | |

The Draft SEIS Eastern Terminus Design Corridor stream and wetland impacts are based on the design corridor width within the field delineated streams and wetlands. The Final SEIS Eastern Terminus stream and wetland impacts are based on preliminary construction limits within the field delineated streams and wetlands.

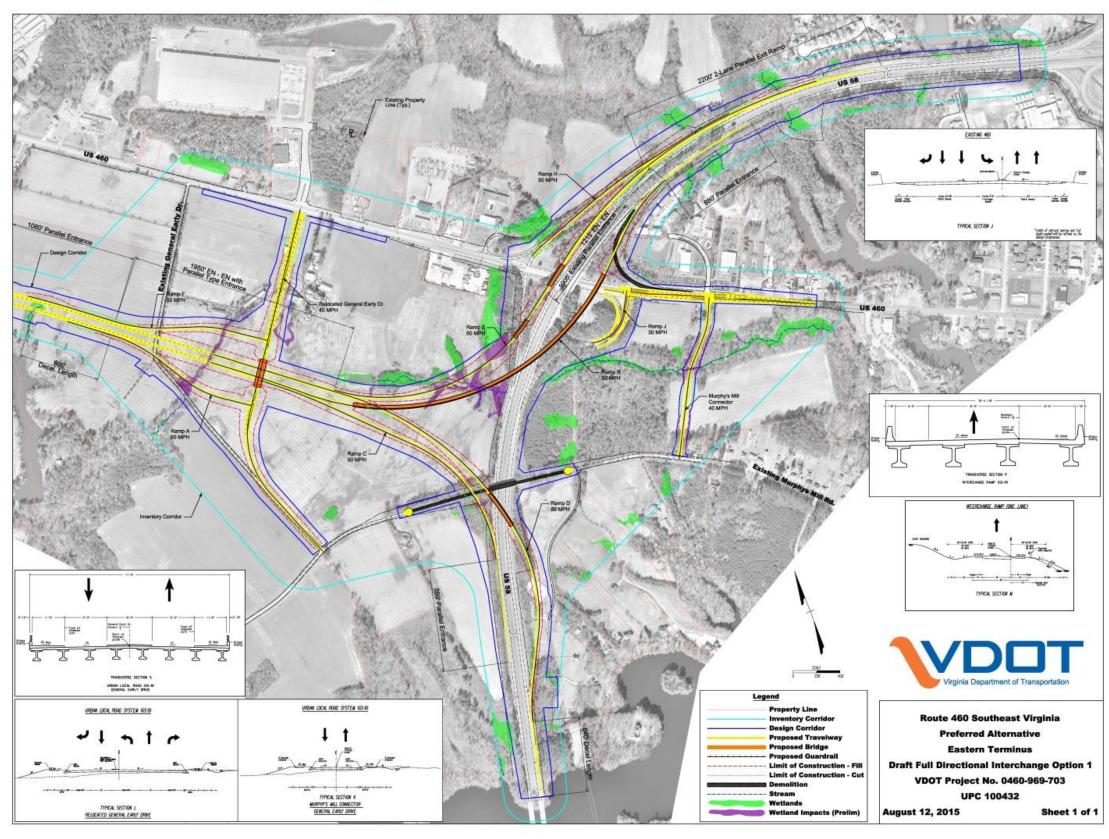
Note: The total Preferred Alternative project cost of \$427 million includes a raw construction cost of \$250 million.

preliminary construction limits within the field delineated streams and wetlands.

The numbers in parentheses represent the revised values for the Eastern Terminus interchange configuration without providing access from relocated General Early Drive.

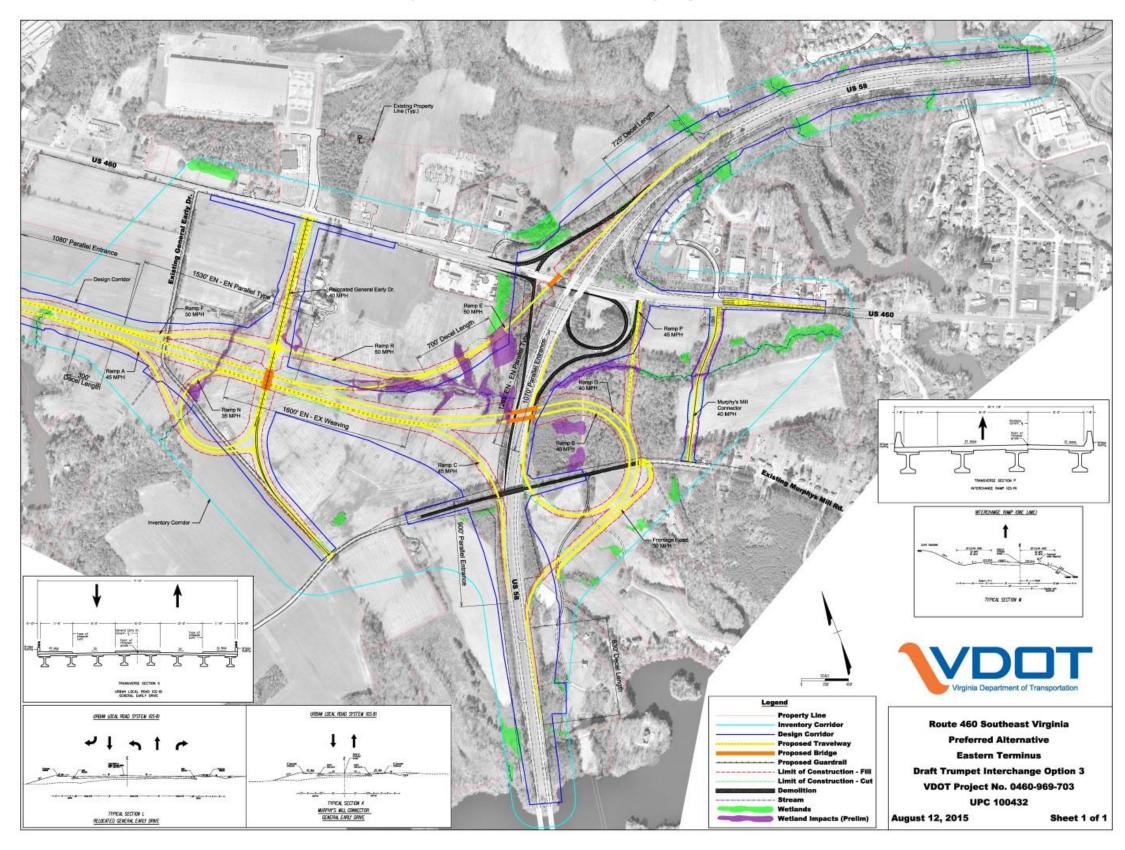
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Figure 2.5-19: Route 460/Route 58 Interchange – Option #1



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Figure 2.5-20: Route 460/Route 58 Interchange – Option #3



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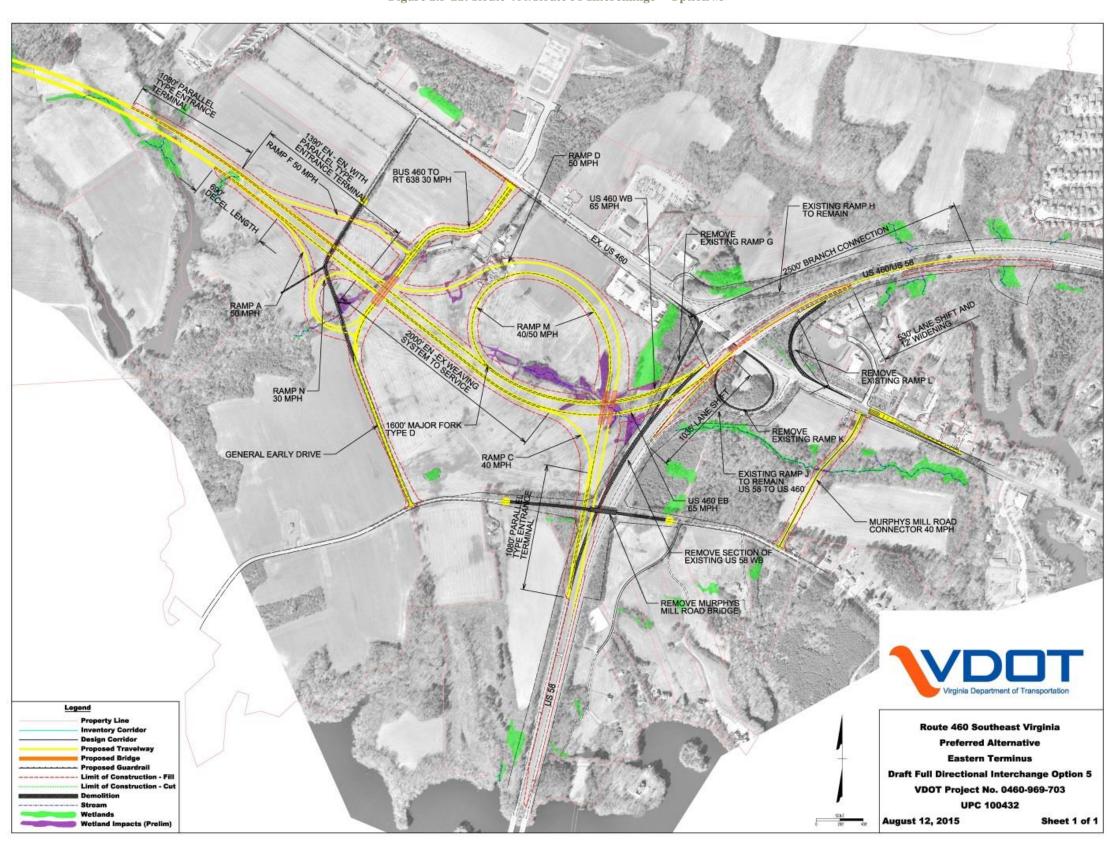


Figure 2.5-21: Route 460/Route 58 Interchange – Option #5

2.5.2.4.1 Route 460/Existing Route 460 West of Windsor

The new Route 460/existing Route 460 crossing on the west side of Windsor is located approximately 12 miles west of Route 58, approximately four miles from the western project terminus, and represents another potential point of access to Route 460 from west of Windsor. This at-grade intersection also represents the terminus of the limited access facility along Route 460 from Route 58 in Suffolk. The following two at-grade configurations were considered for this intersection:

- Traditional four leg intersection
- Three leg intersection

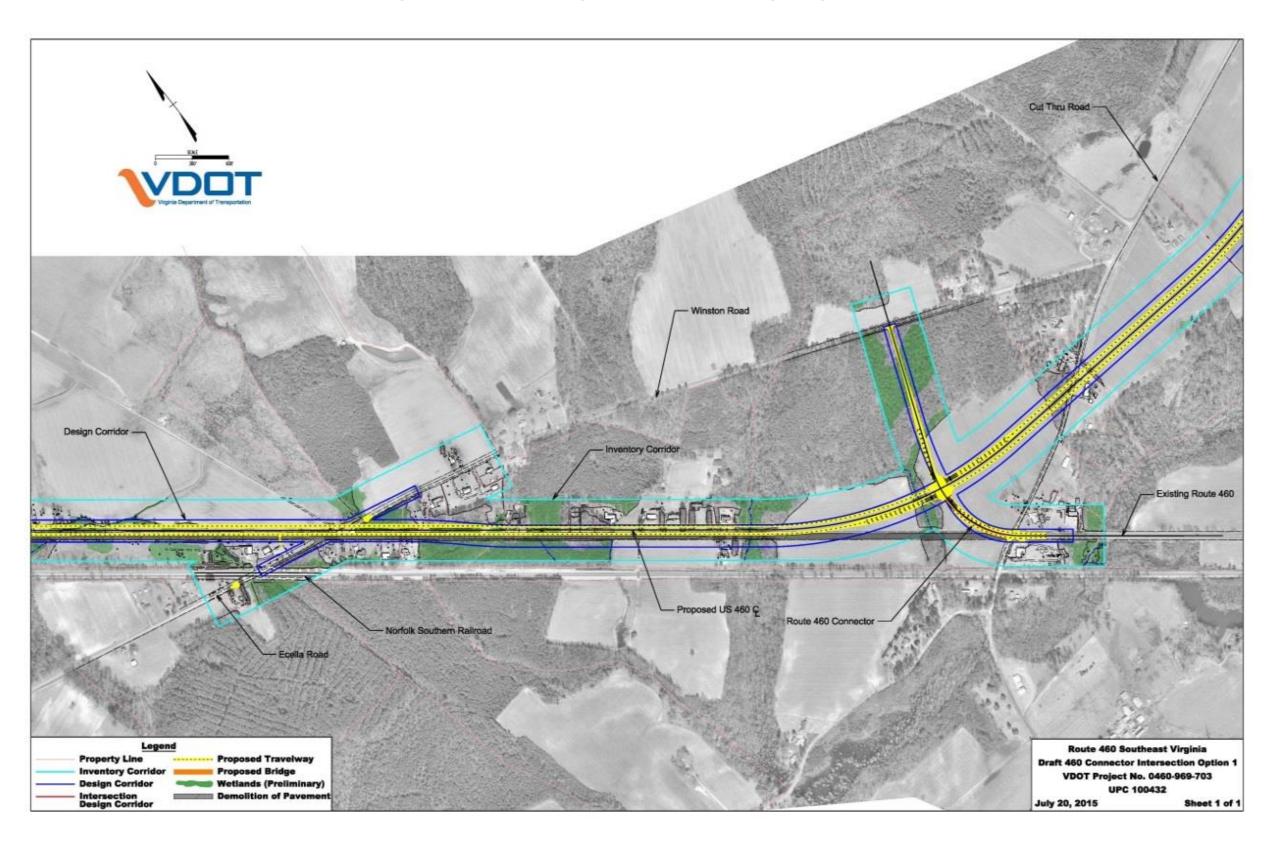
Traditional four leg intersection. In this option, existing Route 460 would curve to connect with new Route 460 on the south side and extend north to intersect with Winston Road. This intersection would be signalized and include right and left turn lanes along both new and improved existing Route 460 based on the traffic analysis. While the intersection would operate at a satisfactory LOS in 2040, the connector portion from Route 460 to Winston Road would impact over one acre of wetlands. Ecella Road would include a new cul-de-sac just south of the Norfolk Southern Railroad crossing to eliminate this existing railroad crossing and improve safety. Traffic that formerly used Ecella Road to access Route 460 would use Yellow Hammer Road, approximately one mile west of Ecella Road. A new driveway would be provided for the property owner located on Ecella Road north of the railroad crossing, providing eastbound access to Route 460. Cut Thru Road would also receive a cul-de-sac just north of new Route 460 and would access new Route 460 along Winston Road and the new 460 connector. The proposed intersection configuration, along with the associate local road improvements, are shown in Figure 2.5-22.

Three leg intersection. In this option, existing Route 460 would curve to connect with new Route 460 on the south side but would not extend north to intersect with Winston Road. This intersection would be signalized and include right and left turn lanes along both new and improved existing Route 460 based on the traffic analysis. This configuration would allow continuous westbound traffic flow along new Route 460 while the remaining traffic movements would be controlled by a traffic signal. This intersection would operate at a better efficiency in 2040 that the four leg intersection and have fewer wetland impacts. Ecella Road would include a new cul-de-sac just south of the Norfolk Southern Railroad crossing to eliminate this existing railroad crossing and improve safety. Traffic that formerly used Ecella Road to access Route 460 would use Yellow Hammer Road, approximately one mile west of Ecella Road. A new driveway would be provided for the property owner located on Ecella Road north of the railroad crossing, providing eastbound access to Route 460. Cut Thru Road would also receive a cul-de-sac just north of new Route 460 and would access new Route 460 along Winston Road. Winston Road would be realigned to reduce the intersection skew with Route 460 and improve sight distance and safety. The proposed intersection configuration, along with the associate local road improvements, is shown in Figure 2.5-23.

Similar to the comparative analyses of interchange options elsewhere along the Preferred Alternative corridor, the two intersection options were evaluated to determine which option would provide cost-effective operational benefits while resulting in the least impacts. Since the three leg intersection configuration would operate at a better efficiency, improve the Winston Road skew, has fewer wetland impacts, and cost similar to the four leg intersection, the Preferred Alternative would include the three leg intersection option at this location.

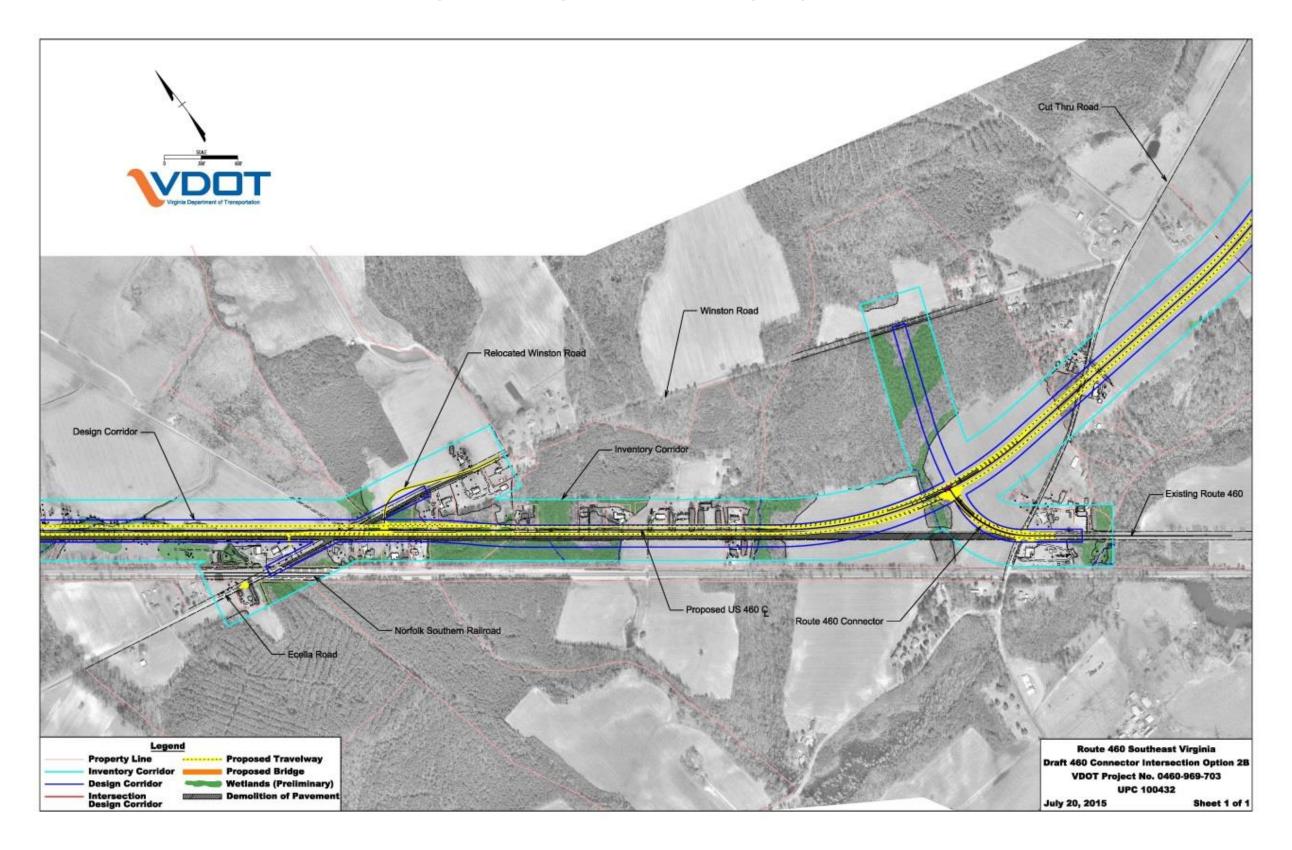
Supplemental Alternatives Technical Report

Figure 2.5-22: Traditional Four leg Intersection - Route 460 crossing Existing Route 460



June 2016
Supplemental Alternatives Technical Report

Figure 2.5-23: Three Leg Intersection - Route 460 crossing Existing Route 460



2.5.2.4.2 Intersections

There are three main intersections within the improved Route 460 section: Route 156 (Zuni Circle/Fire Tower Road); Route 645 (Yellow Hammer Road); and Route 639 (Ecella Road/Winston Drive). Routes 156 and 645 are proposed to remain in place with accommodations for full turning movements. Route 639 would be modified, turning the four leg intersection into a three leg intersection to improve safety. The Ecella Road access would be eliminated, changing the road to a cul-de-sac just south of the Norfolk Southern Railroad crossing; the Winston Drive access would be realigned to reduce the intersection skew, improving sight distance and safety. Traffic that formerly used Ecella Road to access Route 460 would use Yellow Hammer Road, approximately one mile west of Ecella Road. A new driveway would be provided for the property owner located on Ecella Road north of the railroad crossing, providing eastbound access to Route 460. All three intersections include accommodations for full turning movements based on the traffic analysis and are identified in **Table 2.5-4**.

Route
DesignationRoad NameJurisdictionRoute 156Zuni Circle/Fire Tower RoadIsle of Wight CountyRoute 625Yellow Hammer RoadIsle of Wight CountyRoute 602Winston RoadIsle of Wight County

Table 2.5-4: FHWA/VDOT Preferred Alternative – Intersections

2.5.2.4.3 Bridge Structures

The FHWA/VDOT Preferred Alternative includes 12 new bridge structures, excluding the structures associated with the Eastern Terminus. To minimize environmental impact, side road access impacts, and displacements, new Route 460 would cross over the side roads, as compared to the side roads crossing over new Route 460 (as presented in the Draft SEIS). During the avoidance and minimization process, the new Route 460 alignment and corresponding bridges were adjusted to reduce wetland and stream impacts where practicable. For example, the new Route 460 alignment just west of the existing Route 460 crossing was shifted north to avoid environmental impacts and the new bridges over Ennis Pond were reduced several hundred feet from those presented in the Draft SEIS. The FHWA/VDOT Preferred Alternative includes eight new bridge structures over existing roadways. Four additional bridges would be constructed to span waterways, thereby reducing environmental impacts. The bridge over Blackwater River would be the only new bridge within the improved section of US Route 460 west of Windsor. The new bridge locations are listed in **Table 2.5-5**.

| Bridge Location | Jurisdiction |
|---|----------------------------------|
| | Southampton County/Isle of Wight |
| Blackwater River Bridge | County |
| Route 646 (Stave Mill Road) | Isle of Wight County |
| Route 258 (Courthouse Highway) | Isle of Wight County |
| Tributary to Ennis Pond (West of Rt. 600) | Isle of Wight County |
| Route 600 (Deer Path Trail) | Isle of Wight County |
| Tributary to Ennis Pond (West of Rt. 603) | Isle of Wight County |
| Route 603 (Shiloh Drive) | Isle of Wight County |
| Ennis Pond | Isle of Wight County |
| Route 460 | Isle of Wight County |
| Perry Minnow Farm Entrance | City of Suffolk |
| Route 632 (Old Myrtle Road) | City of Suffolk |
| Route 634 (Kings Fork Road) | City of Suffolk |

Table 2.5-5: FHWA/VDOT Preferred Alternative - Bridge Structures

2.5.2.4.4 Western Terminus

The Preferred Alternative does not include an interchange at the terminus of the alignment on the western limits of the proposed roadway improvements. Instead, the improvements connect to the existing Route 460 approximately one mile west of the Blackwater River Bridge in Zuni.

3.0 PRELIMINARY COSTS

In support of the Final SEIS, preliminary cost opinions were developed to determine the anticipated project cost for the FHWA/VDOT Preferred Alternative. For typical NEPA evaluations for transportation projects in Virginia, the VDOT Project Cost Estimating System (PCES) would be used to generate costs for comparison of the alternatives. However, this system does not allow for the comparison of similar typical sections that have differing applications and lacks the flexibility to look at specific roadway configurations. Therefore, study specific cost opinions were developed.

3.1 METHODOLOGY FOR DEVELOPING PRELIMINARY CONSTRUCTION COSTS

A list of typical VDOT pay items was developed for any quantities calculated. These pay items were then placed into categories with those having similar properties or purpose. The categories used are industry standard categories such as earthwork, pavement, drainage, signing and pavement marking, etc. An opinion of the unit cost for each of the construction pay items within each of the construction categories was developed. To the maximum extent possible, VDOT's Hampton Roads District Averages from May 2013 through May 2015 were utilized to develop these unit costs. Engineering judgment was utilized to develop unit cost opinions where pay items were not found in the bid price listing (e.g. wick drains, at-grade railroad crossing, new bridge pay items, etc.). For the purposes of this Preliminary Cost Estimate, the following terms are defined as follows:

- Items The separate pay items, units, and unit costs applicable to the assumed design, such as cubic yards of embankment, tons of asphalt, linear feet of guardrail, etc. Each of the unit costs was researched based on VDOT's Hampton Roads District Averages. Due to the magnitude of this project and the inability to find similar size projects, engineering judgment was applied and unit costs were reduced for the items most likely affected by an economy of scale. As design is at a preliminary stage, engineering judgments were also applied to determine the cost for structure and lighting and ITS pay items. The cost of each new bridge structure is determined by calculating the square footage and classifying by the complexity (e.g., straight, flyover, or river crossing). VDOT Historical Bid Price Listings from February 2011 through March 2013 were utilized to develop the square foot unit price for each bridge type. Due to the preliminary level of design, the cost of some items, such as temporary erosion and sediment control devices, maintenance of traffic items, roadway lighting, and ITS equipment, were determined per linear foot. For example, to estimate roadway lighting costs, a frequency of poles for each portion requiring lighting was assessed and applied to a linear foot length of roadway. The unit price per linear foot included all roadway lighting items (i.e., poles, foundations, luminaires, conduits, wiring, electrical service, etc.).
- Categories The grouping of items of similar properties. Examples of categories include earthwork, pavement, drainage, signing and pavement marking, etc.
- Groups The categories were separated into groups to distinguish quantified pay items, raw construction based pay items, and project pay items (non-construction costs).
 - o *Quantified Group*: Site work, earthwork, pavement, etc. These costs were determined by quantifying the pay items using CADD and calculation.

- o Raw Construction Based Group: CEI, mobilization, preliminary engineering, and contingency. The costs for these categories were calculated by applying a percentage to the raw construction costs (sum of quantified categories costs).
 - 10% for CEI:
 - 5% for mobilization;
 - 10% for preliminary engineering; and
 - 25% for construction contingency.
- o *Project Group*: Right-of-way, utility, and environmental mitigation. These costs were project level costs and they were not directly related to the construction costs.

3.2 OPINION OF PROBABLE COSTS SUMMARY

Table 3.2-1 includes a total construction cost, including contingency and preliminary engineering, for the FHWA/VDOT Preferred Alternative. In addition to preliminary engineering and construction items, costs were developed for the anticipated right-of-way requirements and utility relocations required. A detailed description of the methodology used to calculate the estimated right-of-way and utility relocation costs, along with descriptions of the specific parcels anticipated to be acquired, are found in the *Supplemental Right-of-Way and Relocations Technical Report* (VDOT, 2016g). Environmental mitigation costs include potential wetland, stream, and noise impact mitigation. A detailed description of the methodology used to calculate wetland and stream mitigation costs can be found in the *Supplemental Natural Resources Technical Report* (VDOT, 2016f). A detailed description of the methodology used to calculate noise impact mitigation costs is included in **Appendix E.** Refer to **Appendix C** of the *Supplemental Alternatives Technical Report* (VDOT, 2016e) for the detailed documentation and supporting calculations for the Probable Opinion of Costs developed for each of the pay items, categories, and groups. Costs will be refined during future phases of project development as additional design information is developed.

| Description | Cost (millions) |
|---|-----------------|
| Preliminary Engineering | \$27 |
| Construction ^{1,2,3} | \$314 |
| Right-of-Way & Relocations ⁴ | \$22 |
| Utilities ⁴ | \$17 |
| Environmental Mitigation ⁵ | \$13 |
| SUB-TOTAL | \$393 |
| (without Construction Contingency) | φ373 |
| Construction Contingency ⁶ | \$55 |
| TOTAL | \$448 |

Table 3.2-1: Cost Estimate for the Preferred Alternative (Millions)

NOTES

- 1. Construction costs are based on VDOT Historical Bid Listings from February 2011 through March 2013.
- 2. Construction cost assumptions are detailed in the Alternatives Technical Report Appendix B.
- 3. Construction cost is the sum of raw construction cost, mobilization cost, and construction engineering and inspection cost.
- 4. Right-of-way and utilities costs are detailed in the Supplemental Right-of-Way and Relocations Technical Report.
- 5. Environmental mitigation costs include wetland, stream, and noise impact mitigation. Refer to Natural Resources Technical Report and the Noise Analysis Technical Report for cost methodology and assumptions.
- 6. Construction contingency assumed to be 20% of raw construction cost and is not applied to the preliminary engineering, right-of-way and relocations, utilities, or environmental mitigation costs.

Appendix A

Technical Memorandum

Hybrid Comparison Analysis West of Zuni to Route 58

January 2015



Technical Memorandum

Date: Friday, January 02, 2015

U.S. Route 460 Corridor Improvements Project Project:

> State Project No.: 0460-969-703, P101 Federal Project No.: STP-000S (211)

UPC No: 100432

Hybrid Comparison Analysis West of Zuni to Route 58 Subject:

This technical memorandum compares four corridor alternatives for Route 460 from west of Zuni to Route 58 in Suffolk: No-Build, Alternative 4, Hybrid X and Hybrid B. The memo is divided into the following seven sections: 1) Alternatives, 2) Summary Comparison, 3) Traffic Safety, 4) Traffic Operations, 5) Climate Adaptation and Coastal Resiliency, 6) Benefit Cost Analysis, and 7) Assumptions. This analysis presents an evaluation of each option, comparing advantages and disadvantages relative to the project's ability to meet Purpose and Need while considering impacts to wetlands, right-of-way (displacements) and cost.

ALTERNATIVES

No-Build: Assumes no improvements will be made to Route 460 in the study area before 2040.

Alternative 4: Assumes that existing Route 460 will be upgraded to a four-lane divided highway from West of Zuni to Route 58 in Suffolk. This alternative is a portion of Alternative 4 from the Draft Supplemental Environmental Impact Statement (DSEIS).

Hybrid X: Assumes that existing Route 460 will be upgraded to a four-lane divided highway from west of Zuni to west of Windsor and from east of Windsor to Route 58. From west of Windsor to east of Windsor, a new four-lane grade separated divided highway (i.e. bypass) will be constructed on the north side of Windsor. This alternative is a combination of Alternative 4 and Alternative 2N from the DSEIS. (See

Hybrid B: Assumes that existing Route 460 will be upgraded to a four-lane divided highway from west of Zuni to west of Windsor. From west of Windsor to Route 58 a new four-lane grade separated divided highway will be constructed. This will include a new system-to-system interchange with free-flow ramps at Route 58. The new highway alignment will run north around Windsor (i.e. bypass) and then south of the existing Route 460 from east of Windsor to Route 58. This alternative is a combination of Alternatives 4, 2N, 3 and 1 from the DSEIS. (See Figure 2)

SUMMARY COMPARISON

Table 1 presents a summary comparison of the four alternatives across the major Purpose and Need categories along with impacts to wetlands, right-of-way (displacements) and cost. As shown, the build alternatives offer benefits across several of the categories. However, Hybrid B yields the greatest number of benefits.

Hybrid B is the most effective improvement option that meets the Overall Project Purpose because it yields the lowest corridor crash rate, maximum evacuation capacity, greatest travel time savings and the most effective new route for freight. Unlike Hybrid X, Hybrid B offers an efficient high-speed through

connection while maintaining local access. Hybrid B also includes a free-flow direct connection from the new highway to existing Route 58. Hybrid B is recommended for the following reasons:

- The Hybrid B has the lowest predicted crash rate (49 crashes/100 Million Vehicle Miles), which is 11% lower than Hybrid X (55 crashes/100 Million Vehicle Miles) and 41% lower than the No Build condition (82 crashes/100 Million Vehicle Miles).
- The Hybrid B has 28 traffic conflict points. Hybrid X has 72 traffic conflict points. The Hybrid B has 61% fewer traffic conflict points than Hybrid X.
- The Hybrid B provides the greatest evacuation capacity (13,400 vehicles per hour) which is 160% higher than Hybrid X (5,200 vehicles per hour).
- The Hybrid B provides the ability to reverse the traffic flow on all four new highway lanes and
 three of the four lanes on existing Route 460 in an evacuation event. Hybrid X provides the ability
 to reverse only one of the eastbound lanes providing three westbound evacuation lanes in an
 evacuation event
- The Hybrid B improves safety and mobility by separating local and regional traffic. Hybrid X does
 not separate local and regional traffic because all traffic must pass through the existing Route
 460/58 interchange.
- The Hybrid B is the only alternative that provides a practicable opportunity to restrict through truck traffic along existing Route 460 between the western boundary of Town of Windsor and Route 58.
- The Hybrid B provides the greatest annual travel time cost savings (\$12.6M) of any alternative. This annual cost savings is twice as much as Hybrid X (\$6.3M).
- The Hybrid B provides the greatest corridor travel time savings of any alternative with 840,000 hours saved per year. This is twice as much as the 422,000 annual hours saved by Hybrid X.
- The Hybrid B separates truck traffic from local traffic and shifts trucks to a facility with lower anticipated crash rates. This improves safety because 45% of fatal crashes in the Draft SEIS study area involved tractor trailers. Hybrid X does not separate trucks from the local traffic traveling on Route 460 between east of Windsor and Route 58. Separation of trucks from local traffic also accommodates improved Freight Mobility.
- The Hybrid B better addresses the U.S. Department of Transportation (USDOT) and Corps initiatives to incorporate consideration of climate adaptation and coastal resiliency into their planning processes and investment decisions by providing redundant infrastructure that addresses future environmental risks such as flooding and projected sea-level rise.
- The Hybrid B implements one of the Corps coastal risk reduction measures through nonstructural interventions (evacuation planning).
- The Hybrid B also contributes to system resiliency due to the interdependency of its new roadway component's access to the Virginia Ports and the mobility of freight.
- The Hybrid B has an increased capital cost of \$89 million over Hybrid X. Using a seven percent
 discount rate per USDOT guidelines, this additional investment of capital cost associated with the
 Hybrid B is expected to result in \$128 million in additional benefits, generating a benefit to cost
 ratio of 1.5. At a three percent discount rate, Hybrid B generates \$269 million in additional
 benefits and a benefit to cost ratio of 2.8.

The impacts associated with Hybrid B include 52 acres of wetlands and 22 displacements at a cost of \$427 million. Comparatively, Hybrid X will impact 26 acres of wetlands with 27 displacements at a cost of \$338 million. The details of the summary comparison metrics follow in **Table 1**.

Table 1: Summary Comparison

| | | | | | Safe | ty | | | 1 1 | Hurrican | e Evacuation | Tras | el Tim | e&D | elay | 0. | Wetlands | Displacements | Cost |
|---------------|--------------------------------|----------------------|------------------|--|------------------------------------|---|---|---------------------------|------------------------------|---|---|--------------------------------------|---------------------------------------|-----------------------------|------------------------------|------------------------------------|----------|---------------|-----------|
| Alternative | Est Crashes per 100M Veh Miles | Crash Rate Reduction | es Eliminated pe | Major Through Traffic Conflict Points (West of Windsor to Route 58) | Limited Access Facility | Percent Truck Traffic Diverted to New Route (East of Windsorto Route 58) | Percent Truck Traffic Diverted to New Route (West of Windsor to East of Windsor) | New Dedicated Truck Route | Evacuation Capacity (veh.hr) | US Route 58 Interchange Capacity (veh/hr) | Contraílow Potential | Corridor Travel Time Savings (hr/yr) | Value of Travel Time Saved (\$Mil/yr) | Percent Travel Time Savings | Avg. Speed for Comidor (mph) | Percent Increase in Corridor Speed | Acres | Each | \$ Milion |
| No Build | 82 | -51 | 0 | 176 | No | 0 | 0 | No | 4,800 | 4,800 | Cannot separate local & regional traffic | ō | 0 | 0 | 43 | 0 | 0 | 0 | 0 |
| Alternative 4 | 65 | 21% | 171 | 108 | No | 0 | 0 | No | 5,200 | 4,800 | Cannot separate local & regional traffic | 251,000 | \$3.8 | 6% | 45 | 6% | 10 | 50 | 312 |
| Hybrid X | 55 | 33% | 261 | 72 | Around Windsor | 0 | 60% to 95% | No | 5,200 | 4,800 | Cannot separate local & regional traffic (limited by existing interchange) | | \$6.3 | 11% | 50 | 16% | 26 | 27 | 338 |
| Hybrid B | 49 | 41% | 326 | 28 | Rte 58 to West of Windsor | 80% to 95% | 70% to 95% | Yes | 13,400 | 12,800 | Can separate local & regional traffic | 840,000 | \$12.6 | 16% | 55 | 29% | 52 | 22 | 427 |

TRAFFIC SAFETY

A safety analysis was prepared for the corridor using Highway Safety Manual (HSM) and crash rate analysis methods. A HSM analysis was conducted for the five mile eastern portion of the corridor from east of Windsor to Route 58. As indicated below in **Table 2**, this evaluation demonstrated that the No-Build geometry in this segment is associated with a predicted crash rate of 82 crashes per 100 million vehicle miles (100 MVM) traveled. The No-Build crash predictions and rates are consistent with the historical data presented in the DSEIS Traffic and Transportation Technical Report. Alternative 4 and Hybrid X are associated with 61 crashes per 100 MVM in this part of the corridor. Hybrid B has a crash rate of 39 crashes per 100 MVM on the new highway and 60 crashes per 100 MVM on the existing highway for a combined rate of 43 crashes per 100 MVM.

Table 2: 2040 HSM Predicted Crash Analysis For East of Windsor to US Route 58

| | No-Build | Alternative 4 | Hybrid X | Hybrid B (includes existing Route 460) |
|---------------------------------|----------|---------------|----------|--|
| 2040 Annual Predicted Crashes | 38 | 41 | 41 | 34 |
| Corridor Length | 5.2 | 5.2 | 5.2 | n/a |
| 2040 AADT1 | 24,400 | 35,300 | 35,300 | 49,200 |
| 100 Million Vehicle Miles (MVM) | 0.46 | 0.67 | 0.67 | 0.80 |
| Predicted Crashes Per 100MVM | 82 | 61 | 61 | 43 |
| 2040 Crash Rate Reduction | ¥ | 21% | 21% | 41% |

Based on the predicted crash rates calculated for the east of Windsor to Route 58 segment as well as the historical rate data, crash rate estimates were generated for the remaining 11 miles of the corridor. The resulting corridor crash rates and predicted 2040 crashes are presented in Table 3. This table shows that the build alternatives have lower crash rates than the No Build in 2040. Of the build alternatives, Hybrid B has the lowest crash rate at 49 crashes per 100 MVM, compared to 55 for Hybrid X, 65 for Alternative 4 and 82 for the No-Build option. Using the crash rates, the number of crashes potentially eliminated for each 10,000 vehicles traveling the corridor daily over 20 years was estimated. Hybrid B would eliminate approximately 326 crashes compared to 261 crashes eliminated by Hybrid X for each 10,000 AADT. While the crash rates for the build alternatives are all lower than the No-Build, the predicted number of crashes in the corridor remains similar (113 to 122) because of the traffic volume increases in the build alternatives. As shown in Table 3, Hybrid B serves 65% more traffic than the No-Build and 10% more traffic than Hybrid X with little change in the predicted number of crashes in the corridor.

Table 3: 2040 Corridor Crash Rate Analysis

| | No-Build | Alternative 4 | Hybrid X | Hybrid B |
|---|----------|---------------|----------|----------|
| Weighted Avg Crashes per 100MVM | 82 | 65 | 55 | 49 |
| Crashes Eliminated per 10,000 AADT in the corridor over 15 miles of highway in 20 years | 0 | 171 | 261 | 326 |
| Avg. 2040 Corridor Volume Used for Safety Analysis | 22,500 | 31,000 | 33,800 | 37,300 |
| Corridor Only Crash Prediction Estimate in 20402 | 113 | 122 | 118 | 115 |

Safety benefits within the corridor can also be considered by evaluating the routes that run generally parallel to Route 460. From a regional perspective, there are at least 37,300 vehicles that are predicted to travel east-west in the corridor in 2040. With Hybrid B, all 37,300 vehicles travel on the new or existing Route 460 highways with 115 predicted crashes. For the other three alternatives, some of these 37,300 vehicles are predicted to use other highways. The predicted crashes for all 37,300 vehicles are shown in the first row in Table 4. This includes crashes on Route 460 and other highways in the area including Route 620, Route 606, Route 260, Route 58 and Business Route 58. As shown, Hybrid B reduces the

¹ Alternative 4 and Hybrid X were modeled using the DSEIS Alternative 2 traffic forecast volume and Hybrid B was modeled using the DSEIS Alternative 3 traffic volume

The pipillary of the significant control of the

The similarity of these crash prediction values across all alternatives shows the net effect of a reduced crash rate in the build alternatives, countered by higher volumes due to the increased attractiveness of the route.

number of crashes by 39 (25%) in 2040 and by 690 crashes over a 20 year period compared to 24 (16%) and 425 crashes for Hybrid X.

Table 4: 2040 System Crash Estimates

| | No-Build | Alternative 4 | Hybrid X | Hybrid B |
|---------------------------------------|----------------|---------------|----------|----------|
| 2040 System Crash Prediction Estimate | 154 | 141 | 130 | 115 |
| 2040 System Crash Reduction | 0 | 13 | 24 | 39 |
| Percent System Crash Reduction | i e | 8% | 16% | 25% |
| 20 year Crash Reduction Estimate | 0 | 230 | 425 | 690 |

An HSM analysis was also prepared for the Hybrid B eastern terminus interchange for the year 2040. This analysis showed an approximately 10% reduction in the crash rate resulting from shifting traffic from the existing Route 460/Route 58 interchange to the proposed new system interchange. Hybrid B provides the greatest reduction in predicted crashes by removing traffic from the at-grade intersections at the existing Route 460/Route 58 interchange. This percentage crash rate change was smaller for the interchange than for the corridor analysis because the HSM analysis included the through traffic on Route 58. Hybrid X and Alternative 4 will not reduce the crash rate within the existing Route 460/Route 58 interchange area because no interchange improvements are included in these alternatives.

In addition to the above analysis, through movement conflict points were counted as shown in **Table 1**. Since Hybrid B is access controlled from west of Windsor to Route 58, it has the fewest through conflict points. Hybrid X has 2.5 times as many through movement conflict points followed by Alternative 4 with nearly four times as many and the No Build alternative with over six times as many.

A critical safety consideration is the role that trucks play in severe crashes. Based on the DSEIS, tractor trailers were involved in 45% of fatal crashes in the Route 460 study area. Therefore, separating truck traffic from local traffic and shifting trucks to the safest facilities is beneficial. The Hybrid B alternative does both of these things, while Hybrid X, the No-Build and Alternative 4 leave trucks in the traffic stream on the existing highway.

TRAFFIC OPERATIONS

The traffic operations analysis addresses several key items identified in the Route 460 DSEIS Purpose and Need Statement, including: travel time/delay, freight, and hurricane evacuation. In order to compare the traffic operating characteristics of Alternative 4, Hybrid X, and Hybrid B, a traffic simulation model for the eastern portion of the corridor was developed for the critical PM peak hour. **Table 5** presents the summary results of this analysis. All alternatives are expected to function at LOS C or better across a range of volumes in the eastern portion of the corridor. This demonstrates that highway capacity between the towns is not a major issue.

Travel Time

The predicted 2040 travel time for the 16.6 mile existing corridor is 23.2 minutes (43 mph) as shown in **Table 6**. Alternative 4 decreases travel time to 21.9 minutes (45 mph). Hybrid X decreases travel time to 20.7 minutes (50 mph). Hybrid B decreases travel time the most to 19.5 minutes (55 mph). An estimate of the total annual hours saved in 2040 is provided in Table 6. Hybrid B provides the greatest travel time savings at 840,000 hours annually. This is twice the hours saved by Hybrid X (422,000 hours/year). It is more than three times the Alternative 4 travel time savings (251,000 hours/yr). Assuming a \$15/hr value of time yields an annual travel time cost savings of \$12.6 million in 2040 for Hybrid B. This is twice the 2040 annual travel time cost savings for Hybrid X (\$6.3 million) and more than three times the annual travel time cost savings for Alternative 4 (\$3.8 million).

³ \$15/hour is a reasonable planning value for local travel time savings based on the September 28, 2011 USDOT memorandum regarding Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis.

⁵ Technical Memorandum

Table 5: 2040 PM Peak Hour Traffic Operations (East of Windsor to US Route 58)4

| | | | | Hyb | rid B | | |
|------------------------|-------------------------------|------|------|-----------------|---------------|------|--|
| | Alternative 4 and Hybrid X | | | sting te 460 | New Alignment | | |
| | EB | WB | EB | WB | EB | WB | |
| Density(veh/mi/ln) | 10.8 | 19.3 | 2.3 | 6.4 | 11.1 | 19.7 | |
| Level of Service (LOS) | Α | С | Α | Α | В | С | |
| Average Speed (mph) | 54.2 | 54.8 | 55.3 | 55.9 | 69.0 | 67.4 | |
| Travel Time (minutes) | 7.7 | 7.5 | 101 | - | 5.2 | 4.3 | |

Table 6: 2040 Corridor Travel Time Summary

| | | Travel Time | | | Speed | | Hours | Value of |
|---------------|----------------------|--------------------|-------------|----------------|-------------------|-------------|-------------------|-------------------------|
| 6 | Travel Time (min) | Reduction (min) | % Change | Speed (mph) | Increase (mph) | % Change | Saved per Year | Hours Saved per Year |
| No-Build | 23.2 | 0 | 186 | 43 | 0 | - | 0 | 0 |
| Alternative 4 | 21.9 | 1.3 | 6% | 45 | 3 | 6% | 251,000 | \$3.8M |
| Hybrid X | 20.7 | 2.5 | 11% | 50 | 7 | 16% | 422,000 | \$6.3M |
| Hybrid B | 19.5 | 3.7 | 16% | 55 | 12 | 29% | 840,000 | \$12.6M |

In addition to the travel time analysis, the volume and safety information was used to develop reliability estimates. Specifically, the predicted reliability Planning Time Index was estimated for each option. This index identifies the time required to make sure that a driver will arrive on time 95 percent of the time. Lower values indicate a better reliability because less extra time is required to ensure on-time arrival. Hybrid B has the lowest index value (1.27), which requires a travel time of 24.9 minutes. To ensure on-time arrival, the No-Build requires 31.5 minutes, Alternative 4 requires 33.2 minutes, and Hybrid X requires 29.1 minutes. Hybrid B provides the most reliable alternative because Hybrid B requires four minutes less than Hybrid X to arrive on time.

Hybrid B also provides significant system redundancy with two routes providing connectivity between West of Windsor and Route 58. Therefore, if a major incident were to congest or close one route, traffic could shift to the other route. Hybrid X does not provide that level of system redundancy.

Hurricane Evacuation

Hybrid B provides the greatest evacuation capacity of the four alternatives and can accommodate approximately 13,000 vehicles per hour as shown in Table 1. It provides a nearly three-fold increase over the other alternatives because all four lanes of the new grade separated highway can be operated westbound during an evacuation event. The existing 4-lane Route 460 highway can also be converted to three outbound lanes, resulting in seven total westbound lanes

The proposed new Hybrid B system interchange at Route 58 (with free-flow ramps) also offers the evacuation benefits of increased capacity and the ability to separate local and regional (Route 58) traffic. Given the conceptual bridge designs, the interchange provides continuous flow from Route 58 to all four lanes of the new highway with no intervening intersections. With Hybrid B, the expected evacuation volume of 57,900 vehicles (predicted for a Category 3 hurricane per the DSEIS) could be accommodated in fewer than 5 hours. Evacuation for Hybrid X, Alternative 4, and the No Build will take over 12 hours.

⁴ The volumes used for these operational tests were derived from the DSEIS volumes and provide a reasonable forecast of traffic operating conditions including density and delay

⁶ Technical Memorandum

For the No-Build condition, the existing 4-lane highway can be converted to three outbound lanes during an evacuation emergency. These three lanes have an hourly capacity of approximately 4,800 vehicles. With Alternative 4 and Hybrid X, the mainline capacity could increase to 5,200 total vehicles per hour. Hybrid X has the same evacuation capacity as Alternative 4 because all westbound traffic must pass through the lower capacity eastern section before it reaches the higher capacity bypass Hybrid X, Alternative 4, and the No Build use the existing highway alignment in the east and cannot separate the local and regional traffic because all traffic must pass through the current service interchange using the lower capacity ramps.

Freight Movement

According to the DSEIS, Route 460 is estimated to carry 16% truck traffic. This is a high percentage compared to similar roadways in the region. Based on the data in the DSEIS the average truck percentage is between six and eight percent on several primary routes that serve the Hampton Roads region. Furthermore, according to the DSEIS, approximately 25% of the Route 460 truck traffic is directly related to the ports, with the majority of truck traffic having long-distance origins or destinations outside of the Hampton Roads region.

Hybrid B, with the new highway alignment, offers the most significant benefits for freight mobility because it provides the highest speed (lowest travel time), the best reliability, and lowest crash rate of any of the alternatives. As shown in Table 7, Hybrid B is expected to attract up to 95% of the truck traffic in the corridor assuming the new highway is designated as a truck route and that the current highway is restricted to through truck traffic. Less traffic may divert if the current highway is not restricted to trucks; though at least 70% of the trucks through Windsor and 80% of the trucks east of Windsor are expected to divert.

Hybrid X provides an alternative route around Windsor that is likely to attract between 60% and 95% of the truck traffic though the town while all truck traffic will remain on current Route 460 east of Windsor. Alternative 4 improves the geometry and existing corridor safety, but does not provide a new truck route. The No-Build does not improve travel time, safety, convenience, or accessibility for heavy vehicles.

Table 7: Truck Diversion by Alternative and Segment

| Segment | Hybrid X | Hybrid B |
|------------------------------------|------------|------------|
| West of Windsor to East of Windsor | 60% to 95% | 70% to 95% |
| East of Windsor to Route 58 | n/a | 80% to 95% |

The Hybrid B/Route 58 interchange offers further benefits by providing a direct free-flow connection between Route 58 and the new highway. This connection will simplify and speed access through the Hybrid B corridor. In contrast, Hybrid X utilizes the existing service interchange with Route 58 and does not provide these benefits.

The shift in truck traffic with Hybrid B yields capacity and safety benefits by putting trucks on a lower crash rate facility and separating truck traffic (including through truck traffic) from the local auto traffic on the current Route 460. Based on the DSEIS, tractor trailers were involved in 45% of fatal crashes in the Route 460 study area; therefore shifting them to the new facility is also beneficial for reducing high severity crashes.

Nansemond Suffolk Academy

A qualitative factor considered in the comparison of Hybrid B to Hybrid X, Alternative 4, and the No Build is the presence of the Nansemond Suffolk Academy on Route 460 east of Windsor. The school creates the potential for safety and traffic issues, especially during the hours around the start and end of the school day. The school also includes a speed zone that reduces speeds in the corridor. The presence of the school on Route 460 is not compatible with the high truck traffic volumes in the corridor. Hybrid B is

the only alternative that improves these school related traffic issues because it shifts the truck traffic to a new route.

CLIMATE ADAPTATION AND COASTAL RESILIENCY

When addressing climate change and coastal resiliency, both the built and natural environments need consideration. Incorporating future sea-level changes into the planning, design, construction, operation and maintenance of projects is key in the ability to anticipate, prepare for, adapt, withstand, respond to and recover rapidly from disruptions due to changing conditions to the built and natural environments.

In response to Executive Order No. 13514 and Executive Order No. 13653, the U.S. Department of Transportation (USDOT) and US Army Corps of Engineers (Corps) have taken steps, through the development of Climate Adaption Plans, to incorporate consideration of climate adaptation and coastal resiliency into their planning processes and investment decisions.

Specifically, on December 15, 2014, FHWA issued a Directive through Order No. 5520 to establish their policy on preparedness and resilience to climate change and extreme weather events. USDOTs Climate Adaptation Plan (2014) identified three general vulnerabilities to climate change that focuses on fostering a resilient transportation system as outlined below.

- 1. Existing Infrastructure Resilience: Owned and operated by various public agencies and private entities covering a vast range of ages and service life built to different design standards.
- 2. New Infrastructure Resilience: Newly constructed infrastructure that takes into consideration future environmental risks both in planning and design.
- System Resilience: Transportation systems that are interdependent recognizing that elements of each individual part may be important due to their vital economic role, absence of alternative routes or modes, heavy use or critical function (i.e. emergency evacuation).

Through the Corps 2012 Sustainability Plan, consideration was given to appropriate frameworks and metrics for assessing the efficiency and effectiveness of climate change adaptation activities, which include coastal risk reduction measures. In September 2013, the Corps prepared a report entitled, Coastal Risk Reduction and Resilience: Using the Full Array of Measures, to clarify language used by the USACE to describe the full array of coastal risk reduction measures, which includes a variety of approaches, including natural or nature-based features (e.g., wetlands and dunes), nonstructural interventions (e.g., policies, building codes and emergency response such as early warning and evacuation plans), and structural interventions (e.g., seawalls and breakwaters)⁵.

A Purpose and Need element satisfied by implementing the Route 460 Corridor Improvement Project that addresses projected future sea-level changes includes providing "Adequate Emergency Evacuation Capability". According to the Virginia Hurricane Evacuation Study, a joint effort by the Virginia Department of Emergency Management (VDEM), the Federal Emergency Management Agency, the U.S. Army Corps of Engineers and coastal localities, projected hurricane storm surge flooding along coastal areas are located within (Lake Meade) and adjacently east (Nansemond River) of the project study area. Lake Meade will experience storm surges resulting from a Category Four Hurricane while the Nansemond River will surge as a result of a Category One Hurricane. Hurricane evacuation routes play a critical role to this region and the Hurricane Evacuation network established by VDEM is vulnerable to the loss of Route 460 as one of the key evacuation routes.

Where the Hybrid corridors cross the Blackwater River in Zuni, historical flood data was used to determine the appropriate elevation and limits for the proposed bridge improvements. While both Hybrids B and X follow the same corridor for the majority of the recommended improvements, the improvements east of Windsor to Route 58 differs in that Hybrid X improves existing Route 460 and Hybrid B is on new location south of existing Route 460. In this area, Hybrid B is proposed to be constructed approximately

⁵ US Army Corps of Engineers (2013) Coastal Risk Reduction and Resilience. CWTS 2013-3. Washington, DC: Directorate of Civil Works, US Army Corps of Engineers.

two feet higher than the existing elevation to help address flooding conditions. However, only a portion of Hybrid X in this area is proposed to be constructed two feet higher than existing Route 460. This portion covers approximately half this length and represents the locations that are not currently built up in order to reduce right of way impacts. Furthermore, in an evacuation event Hybrid B provides a more efficient evacuation strategy east of Windsor as it adds over 150 percent more capacity than Hybrid X by using traffic contraflow combined with redundant infrastructure along a new limited access facility. Hybrid B provides a more resilient transportation system by designing new infrastructure that considers both future environmental risks (i.e. flooding) and supports a critical function to coastal communities as an evacuation route. In addition, Hybrid B implements one of the Corps coastal risk reduction measures through nonstructural interventions (evacuation planning). As coastal communities continue to experience an increase in populations of, which is compounded by the increased risk of flooding due to the projected rise in sea-level, providing more capacity through the construction of a redundant transportation system (Hybrid B) would better accommodate travel inland during these storm events.

Another Purpose and Need element satisfied by implementing the Route 460 Corridor Improvement Project that addresses coastal resiliency is the ability for Route 460 to "Accommodate Increasing Freight Traffic". Route 460 is an important shipping route and, therefore, carries a large amount of truck traffic (16%). The Route 460 Corridor Improvements project provides system resilience by addressing the interdependency of the operations at the Virginia Ports and the associated roadway network. Hybrid B better accommodates truck traffic by reducing travel times and enhancing safety. It therefore better provides a more resilient transportation system by supporting the critical functions of the Virginia Ports that include improved access and more efficient mobility for the shipment of goods.

BENEFIT-COST-ANALYSIS

A Benefit-Cost-Analysis (BCA) conceptual framework was performed to compare Hybrids X and B for two purposes: First, it provides a financial measure of project feasibility. Second, it offers a basis for comparing two or more alternatives within a single project. Costs incorporated in the BCA included design costs, capital costs, right-of-way costs, environmental mitigation costs, and operating and maintenance costs (O&M) during the analysis period. The basis of the benefit-cost analysis is the incremental difference between the two alternatives. In general, BCA results in two standard metrics where the streams of future benefits and costs are discounted to today's dollars:

- Net Present Value (NPV) = Discounted Benefits Discounted Costs
- Benefit-Cost Ratio (BCR) = Discounted Benefits / Discounted Costs

The specific methodology developed for this analysis is consistent with United States Department of Transportation (USDOT) guidelines and more detail is included in **Attachment A**. A key consideration in structuring the BCA relates to the timing of construction of the improvements. The capital costs under consideration for the two hybrid alternatives include: preliminary engineering, construction (including construction engineering & inspection), environmental mitigation, utilities, right of way acquisition, and contingency. Potential benefits generated by the Route 460 Corridor Improvements project include the following:

- Travel Time Savings
- Vehicle Operating Costs
- Benefits to New Users
- Safety Benefits
- · Emissions Benefits
- Carbon Dioxide

The table in **Attachment A** summarizes benefits and costs within the corridor of Hybrid B as compared to Hybrid X for proposed alternate build options. Annual costs and benefits are computed and summarized over the life-cycle of the project. Construction of the roadway improvements is expected to take 3 years, with operations available immediately after completion and continuing for 30 years. Benefits will accrue

⁶ U.S. Climate Change Science Program (2009). Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region. Retrieved from http://downloads.globalchange.gov/sap/sap4-1/sap4-1-final-report-all.pdf

⁹ Technical Memorandum

once the new roadway is fully operational. For purposes of this analysis, construction begins in 2015 and is completed by the end of 2017. The selected alternative is operational and benefits begin accruing in

The non-discounted total costs of the project are \$338 million for Hybrid X and \$427 million for Hybrid B. This results in an incremental additional capital cost of \$89 million for Hybrid B. Due to the maintenance of approximately 6 additional roadway miles, Hybrid B has an incremental additional maintenance cost of \$18.0 million over the 30 year analysis period. Using a seven percent discount rate per USDOT quidelines, the additional investment of capital and maintenance costs associated with Hybrid B are expected to result in \$128 million in additional benefits, generating a benefit to cost ratio of 1.5. At a three percent discount rate, the Hybrid B generates \$269 million in benefits and a benefit to cost ratio of 2.8.

ASSUMPTIONS

For the comparison of the Alternatives from west of Zuni to Route 58, assumptions used in the DSEIS were refined to provide a more detailed representation of specific impacts and costs. While the original DSEIS assumptions remain valid, these refinements are an appropriate next step to further evaluate the hybrid features and benefits.

Design Corridor Assumptions (See Figures 3 to 5):

- Hybrid Alternatives B and X include refined engineering resulting in a reduction of the design corridor limits that were used for the DSEIS.
- Hybrid B, Areas 3 and 4 consisted of a 260-ft wide design corridor in the DSEIS and the refined engineering reduced that to 180-ft wide. Area 2 consisted of a 200-ft wide design corridor in the DSEIS and the refined engineering reduced that to 180-ft wide.
- Hybrid X, Area 3 consisted of a 260-ft wide design corridor in the DSEIS and the refined engineering reduced that to 180-ft wide. Areas 2 and 4 consisted of a 200-ft wide design corridor in the DSEIS and the refined engineering reduced that to 180-ft wide.
- The assumed side street lengths were reduced from 750-ft to 500-ft and the side street widths were reduced from 120-ft to 95-ft for the all of the build alternatives discussed in this memorandum.
- The design corridor width for Area 1 remained unchanged between the DSEIS and refined engineering exercise and consists of 105-ft.
- The design corridor width for the new Eastern Terminus was refined to reflect the conceptual design included in the DSEIS.
- The overall acreage reduction within the design corridor for the comparable length of improvement between the DSEIS and Hybrid B is 429 acres.

Wetland Impact Assumptions:

Wetland compensation/mitigation costs were calculated using a 2:1 compensation ratio and a unit cost of \$52,000/acre.

Bridging Assumptions:

Estimate assumes a proposed 490 LF bridge across the Blackwater River thru the Town of Zuni.

Construction Cost Assumptions:

- The assumed unit cost for the mainline typical section was decreased in part because of a reduction in the assumed embankment height due to the proposed design criteria for the alternatives and the specific area being evaluated in this analysis.
- The unit cost of side street improvements was decreased due to revisions to item length and width and revisions to assumptions regarding the proposed embankment height.

Utility Relocation Assumptions:

- Utility relocation costs assume no relocations of existing transmission towers.
- Utility relocation costs assume 25% of franchise utilities are located outside the existing right-ofway and relocation costs would be incurred by the project.

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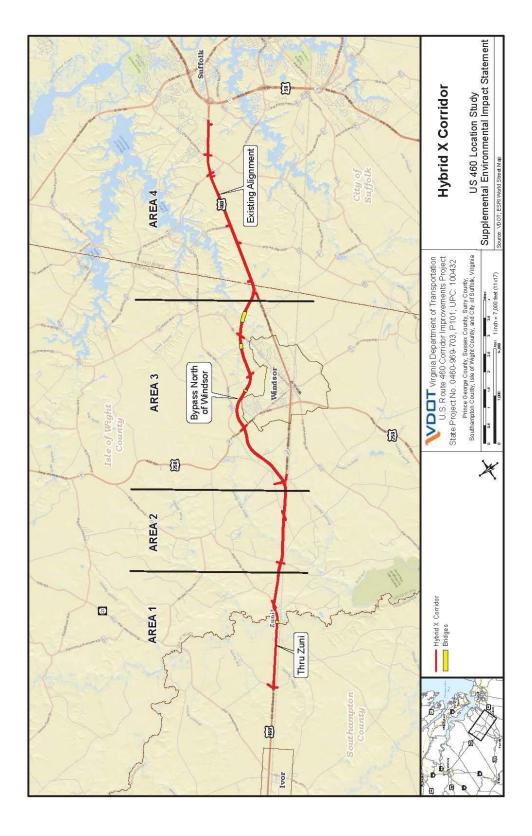


Figure 1

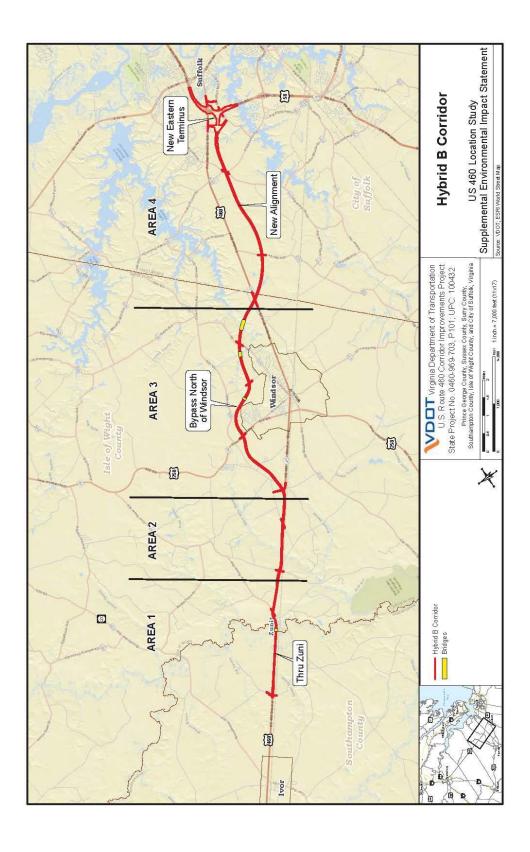
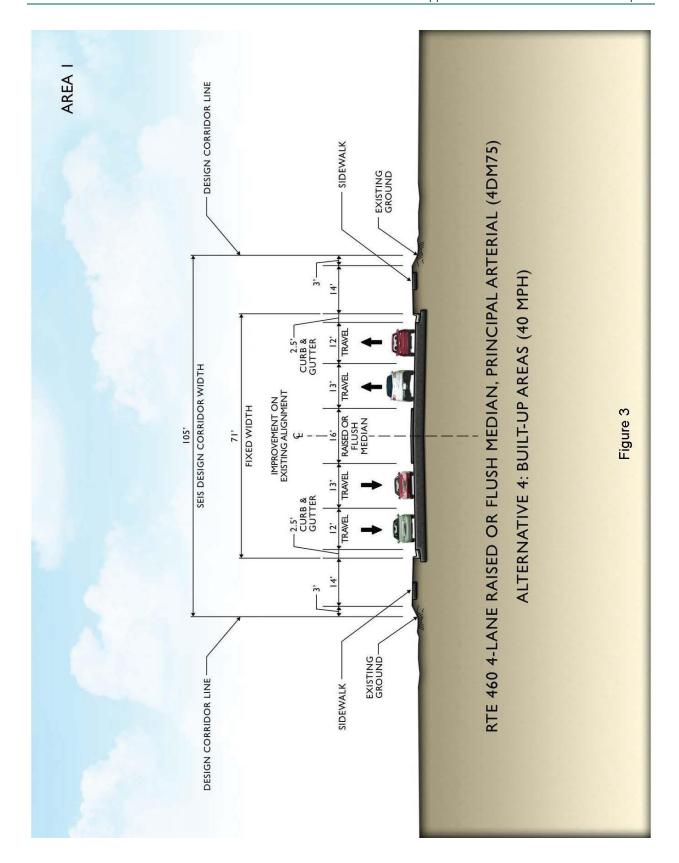


Figure 2



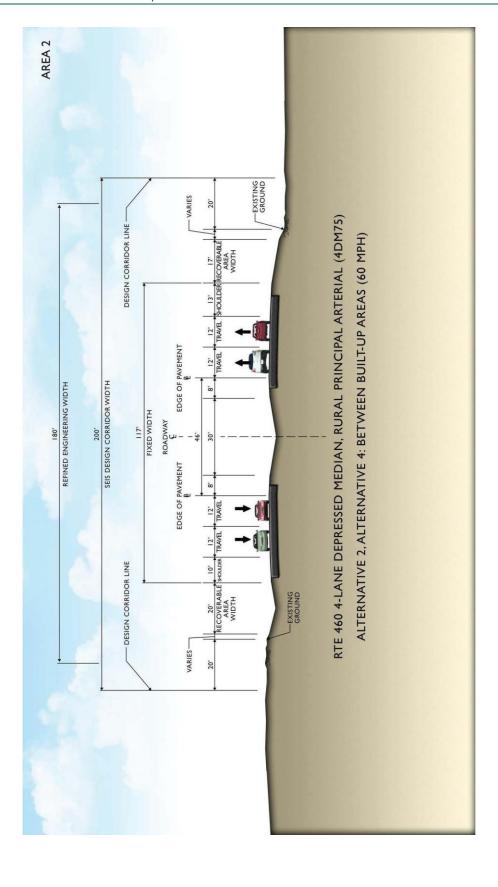


Figure 4

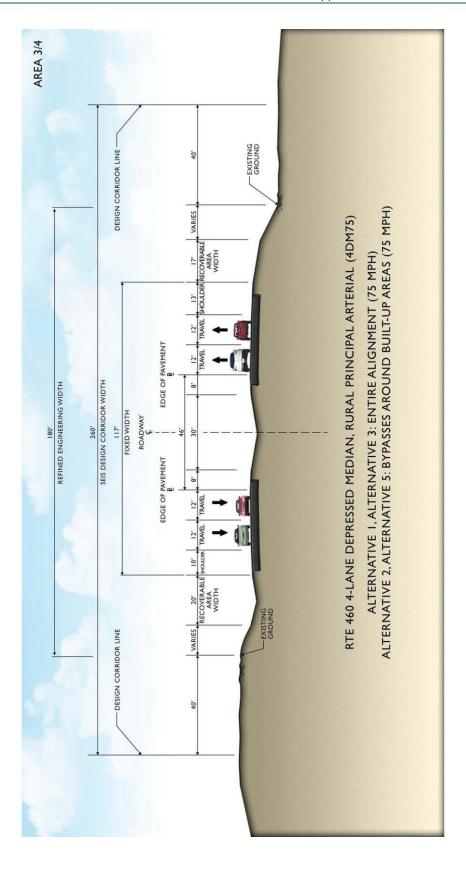


Figure 5



Attachment A

Route 460 Corridor Improvements Benefits and Cost Assessment Hybrid X and Hybrid B Comparison

Introduction

Whether a project is justifiable, and what benefits are most relevant in the assessment, is often based on the perspective of the person or agency making the investment. Policies are in place for regulatory analysis at the federal level, as outlined in the Office of Management and Budget Circulars A-4 and A-94. These two Circulars provide guidance on benefit-cost analysis for regulatory planning, including the suggested use of discount rates. The overarching goal is to show that the benefits of a project outweigh its costs. Societal transportation benefits include reduced emissions, travel time savings, a reduction in vehicle operating costs, and a decrease in accidents, among others.

For the Route 460 Corridor Improvements, the benefits and costs of two alternatives – Hybrid X and Hybrid B – are compared directly to one another.

Benefit-Cost Analysis (BCA) Framework

BCA is a conceptual framework that calculates and compares the benefits and costs of a project. It is considered an industry standard for major transportation infrastructure projects, and it serves two purposes. First, it provides a financial measure of project feasibility. Second, it offers a basis for comparing two or more alternatives within a single project.

Within the BCA framework, benefits are broadly defined. They represent the extent to which people affected by the project are made better off, as measured by their own willingness to pay. In other words, central to BCA is the idea that people are best able to judge what is good for them and to identify what improves their well-being or welfare.

Costs incorporated in a BCA generally include design costs, capital costs, right-of-way costs, environmental mitigation costs, and operating and maintenance costs (O&M) during the analysis period.

When conducting a BCA, a minimum of two alternatives are considered. For this project, two build alternatives that are potentially available for implementation, Hybrid B and Hybrid X, are compared directly to one another. The basis of the benefit-cost analysis is measuring the incremental difference between the two alternatives. The benefits and costs are compared to measure the net value associated with the additional investment. As per the guidance in OMB Circular A4, these two alternatives represent successively stringent options, presenting the total



impacts of each alternative and emphasizing the incremental benefit and cost differences for evaluation.

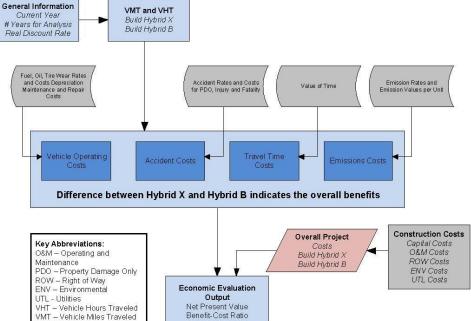
Capital costs and a schedule for construction are estimated for both alternatives. In addition, the operating and maintenance costs and their timing are estimated. Other variables considered are those that may differ between the two alternatives, including anticipated traffic change and safety improvements.

In general, BCA results in two standard metrics where the streams of future benefits and costs are discounted to today's dollars:

- Net Present Value (NPV) = Discounted Benefits Discounted Costs
- Benefit-Cost Ratio (BCR) = Discounted Benefits / Discounted Costs

A structure and logic diagram showing the relationship between the input and output metrics is presented below. General information is combined with vehicle miles traveled (VMT) and vehicle hours traveled (VHT) to estimate transportation benefits. These are compared to costs to calculate the NPV and BCR.

Figure 1: Structure and Logic of Benefit-Cost Analysis for Highway Alternatives





The specific methodology developed for this analysis is consistent with United States Department of Transportation (USDOT) guidelines. The methodology involves:

- Establishing existing and future conditions under the two alternative scenarios;
- Measuring benefits in dollar terms, whenever possible, and expressing benefits and costs in a common unit of measurement;
- Incorporating USDOT guidance for the valuation of travel time savings, safety benefits, and reductions in air emissions, while relying on industry best practices for the valuation of other transportation benefits.

Cost Estimates for Route 460 Corridor Improvements

A key consideration in structuring the BCA relates to the timing of construction of the improvements. The capital costs under consideration for the two alternatives include: preliminary engineering, construction (including construction engineering & inspection), environmental mitigation, utilities, right of way acquisition, and contingency. The total estimated capital cost for Hybrid X is \$338 million and for Hybrid B is \$427 million. Hybrid B is \$89 million more expensive than Hybrid X. The primary cost variations are due to construction and utilities cost differences. Hybrid B construction is more expensive while Hybrid X has greater utility costs. For both alternatives, it is assumed that construction will begin in 2015 and be completed by the end of 2017 with expenditures evenly divided over the time period. It is expected that the improved Route 460 will open for service in 2018.

Hybrid B maintains an additional 6 miles of new roadway as compared to Hybrid X. This results in additional annual maintenance costs of approximately \$427,000¹. Furthermore, these additional road miles will require periodic resurfacing. For purposes of this analysis, it is assumed that this resurfacing will happen every 8 years on average and cost approximately \$1.5 million² more for Hybrid B per occurrence.

Potential Benefits Generated by the Route 460 Corridor Improvements

There are a number of benefits that may result in larger societal gains for one alternative as compared to the other. The following describes each of these benefits, and the results of the BCA are provided in the subsequent section. It should be noted that for purposes of this analysis, benefits begin accruing once construction of the roadway is complete.

TRAVEL TIME SAVINGS

Travel time savings capture the difference in time spent on the road network in Hybrid X as compared to Hybrid B. Travel time savings reflect reductions in travel time (VHT) based on reduced congestion and/or increased speeds with monetization factors (value of time) that vary by trip purpose (personal, trucking, business, etc.). For this analysis, it is assumed that the

¹ This value is based on a per-mile annual average maintenance cost of \$74,272 per 4-lane roadway taken from the Victoria Transport Policy Institute *Transportation Cost and Benefit Analysis II – Roadway Costs*, August 28, 2013, Table 5.6.4-1.

² Calculated based on resurfacing cost in the Virginia Transportation Research Council Report VTRC 07-R31 using the per-lane-mile cost of overlay and milling for SMA 12.5 in Table 9.



value of time is equivalent to \$12.98 per hour for an automobile driver³. It is also assumed that an average of 1.6 people occupy each automobile. For a truck driver, the value of time is assumed to be \$25.75. The value of time increases by 1.6 percent per year to reflect growth in real income and productivity. These monetary values, combined with the travel time savings associated with higher speeds on Hybrid B, result in the total travel time difference between the two alternatives. The total, non-discounted travel time costs on Hybrid X are \$3.6 billion as compared to travel time costs of \$3.1 billion on Hybrid B. This amounts to a non-discounted total travel time savings of \$533.7 million for users within the coridor.

VEHICLE OPERATING COSTS

Vehicle operating costs are those out-of-pocket costs that change with vehicle use; for example, fuel and oil consumption, tire wear, maintenance and repair, and depreciation. Vehicle operating costs may increase or decrease as a result of a transportation improvement, depending on the difference in vehicle miles traveled and average travel speed between the two alternative scenarios. The costs associated with vehicle operation for both automobiles and trucks were obtained through the Highway Economic Requirements System (HERS) Technical Report, 4 updated with other federal data. This cost also includes the cost of excess speed cycles due to congestion. The increased operating speeds on Hybrid B lead to a slight increase in vehicle operating costs when compared to the same travel on Hybrid X. For autos, this increase is offset, on average, by the reduction in excess consumption due to congestion. For trucks, the incremental difference between the two alternatives is an average operating cost increase of \$0.02 per mile on Hybrid B. Overall, the total vehicle operating costs on Hybrid X are \$3.75 billion dollars compared to \$3.78 billion on Hybrid B. This results in slightly higher vehicle operating costs on Hybrid B.

BENEFITS TO NEW USERS

Together, travel time and vehicle operation comprise generalized travel costs. The reduction in total generalized travel costs results in benefits for users while also enticing new users to travel along this portion of the roadway network. These new trips are indicated by the increase in vehicle miles traveled between the two alternatives. Benefits to these new users are estimated using the "rule of one-half," indicating the changes in consumer surplus associated with the lower generalized travel cost due to the roadway improvements. Please note that the change in generalized cost between the two alternatives represents only the change in user costs – travel time and vehicle operating costs. Social costs, including air emissions, accident occurrence, and congestion externalities are assumed to have no impact on trip-making decisions in this analysis. The average benefit to new auto users is \$0.04 per vehicle mile and the average benefit to new trucks is \$0.06 per vehicle mile. These values are strictly applied to the difference in VMT between Hybrid B and Hybrid X and result in a total additional user benefit of \$54.2 million due to the presence of Hybrid B.

³ This is a weighted average of the value of personal (\$12.42) and business (\$25.23) travel assuming 95.4% of trips are personal per U.S. DOT recommendations provided in the *Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis, Revision 2*.

⁴ HERS-ST v20: Highway Économic Requirements System - State Version Technical Report. FHWA-IF-02-060. Federal Highway Administration, Office of Asset Management. Washington DC. August 2002b. Available at: http://www.fhwa.dot.gov/asset/hersst/pubs/tech/tech00.cfm



SAFETY BENEFITS

Safety benefits refer to the monetized value of crashes between the two alternatives. The number of crashes on a road is generally a function of the number of cars that use the road, as well as any safety enhancement measures that have been implemented on the road. Number, frequency and valuation of accidents are divided into fatal, injury and property damage only. The number of crashes, and subsequent benefits vary based on facility, roadway classification, average speed, traffic volumes, and other factors. The crash rates, per 100 million vehicle miles traveled (100MVMT), are lower on Hybrid B than Hybrid X due to differences in roadway type. The average crash rate for Hybrid X is 55.9 crashes per 100MVMT compared to 48.7 million crashes per 100MVMT. The percentage of crashes by severity is then applied to these values to generate total benefits.

According to the U.S. DOT, the average value of a statistical life is \$9.2 million in 2014. The average injury-accident cost is \$106,737. These values increase by 1.07% per year to reflect the growth in real income. Property damage only accidents are valued at \$3,927. When compared directly to one another, Hybrid B results in slightly greater accident costs than Hybrid X due to the greater number of vehicle miles traveled on this corridor. The total accident cost for Hybrid X is \$419.2 million while the total accident cost for Hybrid B is \$451.5 million. The analysis strictly looks at the difference between the two corridors and not the broader network effects, resulting in a conservative estimate of the overall safety benefits.

EMISSIONS BENEFITS

Air pollution levels can increase or decrease as a result of a transportation infrastructure project. This analysis considers the total amount of volatile organic compounds, nitrogen oxides, fine particulate matter, sulfur dioxide, and carbon dioxide released into the atmosphere under Hybrid X and Hybrid B. Emissions are typically a function of VMT and travel speed. As VMT increases, emissions generally increase. If a roadway is likely to increase the amount of vehicle travel, emissions are likely to increase generating an emissions cost. Speed plays a role as well, with vehicle emissions being heaviest at very low and very high speeds. Emission rates are generated by the Environmental Protection Agency's MOVES model. These emission rates vary by vehicle type, year and speed.

For the analysis, the following costs per metric ton are assumed for different types of emissions:

| • | Volatile Organic Compounds | \$1,999 |
|---|----------------------------|-------------------|
| | Nitrogen Oxides | \$7,877 |
| | Fine Particulate Matter | \$360,383 |
| • | Sulfur Dioxide | \$46,561 |
| • | Carbon Dioxide | \$61 ⁵ |

The total emissions cost of Hybrid X is \$115.0 million and the total for Hybrid B is \$131.3 million.

⁵ The value for carbon dioxide is for the year 2034. The value of carbon dioxide changes annually according to the US DOT. Carbon emissions are also always discounted at a rate of 3%.



Benefit-Cost Analysis Findings

Tables 1 and 2 below summarize the benefits and costs of Hybrid B as compared to Hybrid X for proposed alternate build options. Annual costs and benefits are computed and summarized over the life-cycle of the project. Construction of the roadway improvements is expected to take 3 years, with operations available immediately after completion and continuing for 30 years. Benefits will accrue once the new roadway is fully operational. For purposes of this analysis, construction begins in 2015 and is completed by the end of 2017. The selected alternative is operational and benefits begin accruing in 2018.

The non-discounted total costs of the project are \$338 million for Hybrid X and \$427 million for Hybrid B. This results in an incremental additional capital cost of \$89 million for Hybrid B. Due to the maintenance of approximately 6 additional roadway miles, Hybrid B has an incremental additional maintenance cost of \$18.0 million over the 30 year analysis period. Using a seven percent discount rate per USDOT guidelines, the additional investment of capital and maintenance costs associated with Hybrid B are expected to result in \$128 million in additional benefits, generating a benefit to cost ratio of 1.5. At a three percent discount rate, the Hybrid B generates \$269 million in benefits and a benefit to cost ratio of 2.8.

Table 1: Benefit-Cost Analysis Results, 7% Discount Rate

| Direct Comparison (in Millions of 2014\$), 7% Discount Rate | | | | | | | | | | |
|---|-----------|-----------|----------|--|--|--|--|--|--|--|
| MEASURES | Hybrid X | Hybrid B | Benefit | | | | | | | |
| Travel Time Cost for Existing Users | \$3,587.2 | \$3,053.6 | \$533.7 | | | | | | | |
| Vehicle Operating Cost for Existing Users | \$3,745.5 | \$3,781.0 | (\$35.5) | | | | | | | |
| Safety Cost | \$419.2 | \$451.5 | (\$32.4) | | | | | | | |
| Non-Carbon Emissions | \$49.3 | \$54.4 | (\$5.1) | | | | | | | |
| Carbon Emissions | \$180.8 | \$208.3 | (\$27.5) | | | | | | | |
| TOTAL COSTS BY CORRIDOR | \$7,982.0 | \$7,548.8 | \$433.2 | | | | | | | |
| Economic Value to New Users on Hybrid B | \$0.0 | \$54.2 | \$54.2 | | | | | | | |
| TOTAL BENEFITS OF HYBRID B OVER HYBRID X | | | \$487.4 | | | | | | | |
| PV of Total Net Benefits of Hybrid B | | | \$128.3 | | | | | | | |
| COSTS | | | | | | | | | | |
| Capital Costs | \$337.7 | \$426.7 | (\$89.0 | | | | | | | |
| Maintenance Costs | \$69.6 | \$87.6 | (\$18.0) | | | | | | | |
| TOTAL ADDITIONAL COSTS OF HYBRID B | \$407.3 | \$514.2 | \$106.9 | | | | | | | |
| PV of Total Costs | | | \$83.6 | | | | | | | |
| Net Present Value (NPV) | | | \$44.7 | | | | | | | |
| | | | | | | | | | | |



Table 2: Benefit-Cost Analysis Results, 3% Discount Rate

| Direct Comparison (in Millions of 2014\$), 3% Discount Rate | | | | | | | | | |
|---|-----------|-----------|----------|--|--|--|--|--|--|
| MEASURES | Hybrid X | Hybrid B | Benefit | | | | | | |
| Travel Time Cost for Existing Users | \$3,587.2 | \$3,053.6 | \$533.7 | | | | | | |
| Vehicle Operating Cost for Existing Users | \$3,745.5 | \$3,781.0 | (\$35.5) | | | | | | |
| Safety Cost | \$419.2 | \$451.5 | (\$32.4) | | | | | | |
| Non-Carbon Emissions | \$49.3 | \$54.4 | (\$5.1) | | | | | | |
| Carbon Emissions | \$180.8 | \$208.3 | (\$27.5) | | | | | | |
| TOTAL COSTS BY CORRIDOR | \$7,982.0 | \$7,548.8 | \$433.2 | | | | | | |
| Economic Value to New Users on Hybrid B | \$0.0 | \$54.2 | \$54.2 | | | | | | |
| TOTAL BENEFITS OF HYBRID B OVER HYBRID X | | | \$487.4 | | | | | | |
| PV of Total Net Benefits of Hybrid B | | | \$268.9 | | | | | | |
| COSTS | | | | | | | | | |
| Capital Costs | \$337.7 | \$426.7 | (\$89.0) | | | | | | |
| Maintenance Costs | \$69.6 | \$87.6 | (\$18.0) | | | | | | |
| TOTAL ADDITIONAL COSTS OF HYBRID B | \$407.3 | \$514.2 | \$89.0 | | | | | | |
| PV of Total Costs | | | \$94.5 | | | | | | |
| Net Present Value (NPV) | | | \$174.4 | | | | | | |
| Benefit-Cost Ratio (BCR) | | | 2.8 | | | | | | |

The tables above show the costs associated with each category for each alternative as well as the incremental benefits, and the following bullets summarize the results of the analysis. As noted previously, BCA is an industry-accepted approach to determining whether a project should proceed based on the societal benefits it is likely to generate. The Benefit-Cost Ratio reflects the amount of societal benefit generated by \$1 of investment.

- Travel Time Savings for Existing Users, with non-discounted benefits of \$533.7 million, is the largest benefit category for the Project. This benefit accounts for the time savings associated with an increased average speed for those users on Hybrid B as compared to those on Hybrid X.
- The economic value to new users is the second largest category of benefits, accounting
 for \$54.2 million. While the analysis does not exclusively account for new trips, this
 reflects additional vehicle miles traveled along this specific corridor due to the
 construction of Hybrid B.
- Safety changes are conservatively estimated to cost an additional \$32.4 million over the project life. This is a conservative and somewhat deceptive number, as the accident rate is lower on Hybrid B than on Hybrid X (49 crashes per 100 million VMT compared with 56 crashes per 100 million VMT), but this improved safety rate is offset by additional VMT traveling on this corridor. As the travel demand model does not exclusively



consider new trips, these vehicles are diverted from other routes that are not explicitly considered in this analysis. Thus, while the safety cost on this specific corridor may increase, it is likely that the overall safety in the broader network has increased.

- Hybrid B does generate a higher rate of emissions from vehicles, an additional \$32.6 million over the study period. This is due to a combination of the additional vehicle miles traveled on Hybrid B as well as the higher speeds.
- The final category of benefits is vehicle operating cost savings for existing users. This category, an additional cost to users of \$35.5 million, considers the costs of operating a vehicle fuel, tires, oil, maintenance & repair, and depreciation. The average additional user cost per-mile for an auto is \$0.00 and for a truck is \$0.02. The cost differential is primarily due to the variation in operating speeds, which influence the consumption rates and the rate of wear-and-tear on vehicles.

Appendix B

Refined Hybrid Detailed Metrics

| | NOR | TH BYPA | SS OF | WINDSC |)R | | | | | | |
|--|---|------------------|-----------------------------|---------|------|--------|---------|-----------------------|----|----------------|-------------------------------|
| Northern By | rpass around Windsor, comparing Zuni bypass vs NO Zuni bypass, with NO new interchange at Rt 58 | | WETLAND DISPLACEMENTS | | | | | | | COST | |
| | | IMPACTS | (AC) | _ | | | | | | Const | \$ 253 Mi |
| | | | | Res | Comm | Farm | N-P | | | PE | \$ 22 Mi |
| Alt 2N | ZUNI BYPASS, BRIDGE OVER THE BLACKWATER RIVER, | Area 1 | 25 3 | 6 | 1 | 0 | 0 | Residential | 20 | ENV | \$ 5 Mi \$ 38 Mi |
| 17 miles | EAST OF WINDSOR TO EASTERN TERMINUS ALONG EXIST. ALIGNMENT | Area 2 Area 3 | 19 | 3 | 0 | 0 | 1 | Commercial Farming | 0 | UTIL RW | \$ 38 Mi |
| | | Area 4 | 2 | 11 | 1 | 0 | 0 | Non-Profit | 1 | Cont | \$ 55 Mi |
| | | Total | 49 | 20 | 2 | 0 | 1 | Total | 23 | Total | \$ 393 Mi |
| | | | | _ | _ | _ | | Total | | Const | \$ 208 Mi |
| | | | | Res | Comm | Farm | N-P | | | PE | \$ 18 Mi |
| Alts 4/2N | THRU TOWN OF ZUNI, BRIDGE OVER THE BLACKWATER RIVER, | Area 1 | 3 | 10 | 2 | 0 | 0 | Residential | 24 | ENV | \$ 3 Mi |
| 17 miles | EAST OF WINDSOR TO EASTERN TERMINUS ALONG EXIST. ALIGNMENT | Area 2 Area 3 | 3 19 | 0 | 0 | 0 | 0 | Commercial | 3 | UTIL RW | \$ 44 Mi \$ 22 Mi |
| | | Area 4 | 19 | 3 11 | 1 | 0 | 1 | Farming Non-Profit | 0 | Cont | \$ 22 Mi |
| | | Total | 27 | 24 | 3 | 0 | 1 | Total | 28 | Total | \$ 338 Mi |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| l . | | | | | | | | | | | |
| Improven | nents along existing 460 thru Windsor, comparing Zuni bypass vs NO Zuni bypass, with NO new interchange at Rt 58 | WETLAI | ND. | | | | | | | 1 | |
| | Zuiii bypass, with NO new interchange at it 56 | | IMPACTS (AC) DISPLACEMENTS | | | | COST | | | | |
| | | | (11) | Res | Comm | Farm | N-P | | | Const PE | \$ 201 Mi |
| | ZUNI BYPASS, BRIDGE OVER THE BLACKWATER RIVER, | Area 1 | 25 | 6 | 1 | 0 | 0 | Residential | 28 | ENV | \$ 3 Mi |
| Alts 2N/4 | EAST OF WINDSOR TO EASTERN TERMINUS ALONG EXIST. ALIGNMENT | Area 2 | 3 | 0 | 0 | 0 | 0 | Commercial | 13 | UTIL | \$ 65 Mi |
| 17 miles | | Area 3 | 2 | 11 | 11 | 0 | 4 | Farming | 0 | RW | \$ 37 Mi |
| | | Area 4 | 2 | 11 | 1 | 0 | 0 | Non-Profit | 4 | Cont | \$ 44 Mi |
| | | Total | 32 | 28 | 13 | 0 | 4 | Total | 45 | Total | \$ 367 Mi |
| | TUDU TOWALOF TUBU DDIDGE OVED THE DIAGRAMATED DIVED | | | Res | Comm | Farm | N-P | | | Const | \$ 155 Mi |
| | THRU TOWN OF ZUNI, BRIDGE OVER THE BLACKWATER RIVER, BETWEEN ZUNI BYPASS AND WINDSOR BYPASS | Area 1 | 2 | 10 | 2 | 0 | 0 | Residential | 32 | PE ENV | \$ 14 Mi \$ 1 Mi |
| Alt 4 | THRU TOWN OF WINDSOR | Area 2 | 3 | 0 | 0 | 0 | 0 | Commercial | 14 | UTIL | \$ 70 Mi |
| 17 miles | EAST OF WINDSOR TO EASTERN TERMINUS ALONG EXIST. ALIGNMENT 4 LANES DIVIDED | Area 3 | 2 | 11 | 11 | 0 | 4 | Farming | 0 | RW | \$ 40 Mi |
| | 15 1125 5111525 | Area 4 | 2 | 11 | 1 | 0 | 0 | Non-Profit | 4 | Cont | \$ 32 Mi |
| | | Total | 10 | 32 | 14 | 0 | 4 | Total | 50 | Total | \$ 312 Mi |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| Southern By | pass around Windsor, comparing Zuni bypass vs NO Zuni bypass, with NO new interchange at Rt 58 | WETLAI | up. | | | | | | | 1 | |
| | NO new interchange at Rt 56 | IMPACTS | | | | DISPLA | CEMENTS | | | | COST |
| | | | , | D. | C-1 | F- | N.S | | | Const | \$ 244 Mi |
| | | | | Res | Comm | Farm | N-P | | | PE | \$ 21 Mi |
| Alt 2S | ZUNI BYPASS, BRIDGE OVER THE BLACKWATER RIVER, | Area 1 | 25 | 6 | 1 | 0 | 0 | Residential | 19 | ENV | \$ 9 Mi |
| 17 miles | EAST OF WINDSOR TO EASTERN TERMINUS ALONG EXIST. ALIGNMENT | Area 2 Area 3 | 3 | 0 | 0 | 0 | 0 | Commercial | 6 | UTIL | \$ 42 Mi |
| | | | 58 2 | 2 11 | 1 | 0 | 0 | Farming Non-Profit | 0 | RW Cont | \$ 22 Mi \$ 53 Mi |
| | | Area 4 Total | 88 | 19 | 6 | 0 | 0 | | | | |
| | | iotai | - 00 | 13 | | - | - | Total | 25 | Total Const | \$ 391 Mi \$ 199 Mi |
| | THRU TOWN OF ZUNI, BRIDGE OVER THE BLACKWATER RIVER | | | Res | Comm | Farm | N-P | | | PE | \$ 199 Mi |
| /=- | BETWEEN ZUNI BYPASS AND WINDSOR BYPASS | Area 1 | 3 | 10 | 2 | 0 | 0 | Residential | 23 | ENV | \$ 7 Mi |
| Alts 4/2S 17 miles | BYPASS SOUTH OF WINDSOR EAST OF WINDSOR TO EASTERN TERMINUS ALONG EXIST. ALIGNMENT | Area 2 | 3 | 0 | 0 | 0 | 0 | Commercial | 7 | UTIL | \$ 47 Mi |
| 17 miles | 4 LANES DIVIDED | Area 3 | 58 | 2 | 4 | 0 | 0 | Farming | 0 | RW | \$ 24 Mi |

| Northorn Ru | pass around Windsor, comparing Zuni bypass vs NO Zuni bypass, and | | | | | | | | | | |
|----------------------------|--|------------------|---------------|---------------|-------|--------|-------------|---------------------------|---------|-------------|--|
| Northern by | NEW interchange at Rt 58 | WETLAN | | | | DISPLA | ACEMENTS | | | (| COST |
| | | | Ì | Dee | Comm | Fa | N.D. | | | Const | \$ 332 Mi |
| | ZUNI BYPASS, BRIDGE OVER THE BLACKWATER RIVER | | | Res | Comm | Farm | N-P | | | PE | \$ 29 Mi |
| Alts 2N/3 | BETWEEN ZUNI BYPASS AND WINDSOR BYPASS | Area 1 | 25 | 6 | 1 | | 0 | Residential | 11 | ENV | \$ 8 M |
| 17 miles | BYPASS NORTH OF WINDSOR EAST OF WINDSOR TO EASTERN TERMINUS ALONG NEW ALIGNMENT | Area 2 | 3 | 0 | 0 | C | 0 | Commercial | 2 | UTIL | \$ 19 M |
| 17 1111103 | 4 LANES DIVIDED | Area 3 | 18 28 | 3 | 0 | | 1 | Farming Non-Profit | 3 | RW Cont | \$ 20 Mi \$ 72 Mi |
| | | Area 4 | | | 1 | . 3 | 0 | Non-Pront | 1 | Cont | † |
| | | Total | 74 | 11 | 2 | 3 | 1 | Total | 17 | Total | \$ 480 Mi |
| | THE HAND OF THE PROOF OF THE PLACEMATER BUTTO | | | Res | Comm | Farm | N-P | | | Const | \$ 287 Mi |
| A 14 - | THRU TOWN OF ZUNI, BRIDGE OVER THE BLACKWATER RIVER BETWEEN ZUNI BYPASS AND WINDSOR BYPASS | | | 40 | - | | | Davids setal | 45 | PE | \$ 25 Mi |
| Alts 4/2N/3 | BYPASS NORTH OF WINDSOR | Area 1 Area 2 | 3 | 10 | 2 | | 0 | Residential Commercial | 15 3 | ENV UTIL | \$ 5 Mi \$ 24 Mi |
| | EAST OF WINDSOR TO EASTERN TERMINUS ALONG NEW ALIGNMENT | Area 3 | 18 | 2 | 0 | |] 1 | Farming | 3 | RW | \$ 24 Mi |
| 17 miles | 4 LANES DIVIDED | Area 4 | 28 | 2 | 1 | 3 | 0 | Non-Profit | 1 | Cont | \$ 63 Mi |
| | | Total | 52 | 15 | 3 | 3 | | Total | 22 | Total | \$ 427 Mi |
| | | 70441 | | 1.0 | | | 1 - | Total | | Total | ψ 427 IVII |
| | | | | | | | | | | | |
| Improvem | eents along existing 460 thru Windsor, comparing Zuni bypass vs NO Zuni bypass, and NEW interchange at Rt 58 | WETLA | | | | DISPLA | ACEMENTS | | | COST | |
| | | IMPACTS | (AC) | | | 1 | | 1 | | | |
| | | | | Res | Comm | Farm | N-P | | | Const | \$ 277 Mi |
| Alts 2N/4/3 17 miles | ZUNI BYPASS, BRIDGE OVER THE BLACKWATER RIVER BETWEEN ZUNI BYPASS AND WINDSOR BYPASS | | | | | | | | 20 | PE | \$ 24 Mi |
| | THRU TOWN OF WINDSOR | Area 1 | 25 | ь | 0 | | 0 | Residential | 20 | ENV | \$ 6 Mi |
| | EAST OF WINDSOR TO EASTERN TERMINUS ALONG NEW ALIGNMENT | Area 2 Area 3 | 3 | 11 | 11 | | 1 4 | Commercial Farming | 13 | UTIL RW | \$ 45 Mi \$ 36 Mi |
| | 4 LANES DIVIDED | Area 4 | 29 | 3 | 11 | | 0 | Non-Profit | 4 | Cont | \$ 60 Mi |
| | | Total | 59 | 20 | 13 | | 4 | Total | 40 | Total | \$ 448 Mi |
| | | | - 55 | | | | | TOLAI | 40 | Const | \$ 232 Mi |
| | | | | Res | Comm | Farm | N-P | | | PE | \$ 20 Mi |
| | THRU TOWN OF ZUNI, BRIDGE OVER THE BLACKWATER RIVER THRU TOWN OF WINDSOR ON EXISTING ALIGNMENT | Area 1 | 3 | 10 | 2 | | 0 | Residential | 24 | ENV | \$ 4 Mi |
| Alts 4/3 | EAST OF WINDSOR TO EASTERN TERMINUS ALONG NEW ALIGNMENT | Area 2 | 3 | 0 | 0 | C | 0 | Commercial | 14 | UTIL | \$ 50 Mi |
| 17 miles | 4 LANES DIVIDED | Area 3 | 2 | 11 | 11 | | 4 | Farming | 3 | RW | \$ 38 Mi |
| | | Area 4 | 29 | 3 | 1 | . 3 | 0 | Non-Profit | 4 | Cont | \$ 50 Mi |
| | | Total | 37 | 24 | 14 | . 3 | 4 | Total | 45 | Total | \$ 394 Mi |
| | | | | | | | | | | | |
| Southern By | pass around Windsor, comparing Zuni bypass vs NO Zuni bypass, and NEW interchange at Rt 58 | WETLA | ND | DISPLACEMENTS | | | | | | COST | |
| | | IMPACTS | (AC) | | | | TCEIVIEIVIS | | | | |
| | | | | Res | Comm | Farm | N-P | | | Const | \$ 346 Mi |
| | ZUNI BYPASS, BRIDGE OVER THE BLACKWATER RIVER | | | | | | | | | PE | \$ 30 Mi |
| Alts 2S/1 | BETWEEN ZUNI BYPASS AND WINDSOR BYPASS BYPASS SOUTH OF WINDSOR | Area 1 | 25 | 6 | 1 | | 0 | Residential | 12 | ENV | \$ 14 Mi |
| 17 miles | EAST OF WINDSOR TO EASTERN TERMINUS ALONG NEW ALIGNMENT | Area 2 | 3 | 0 | 0 | | 1 0 | Commercial | 3 | UTIL | \$ 22 Mi |
| | 4 LANES DIVIDED | Area 3 & 4 | 102 | 6 | 2 | . 1 | . 0 | Farming Non-Profit | 0 | RW Cont | \$ 20 Mi \$ 75 Mi |
| | | Tarel | 430 | 43 | _ | 1 . | | | | | i |
| | | Total | 130 | 12 | 3 | 1 | . 0 | Total | 16 | Total | \$ 507 Mi |
| | | | | Res | Comm | Farm | N-P | | | Const PE | \$ 301 Mi |
| | THREE TOWN OF THREE PROCESS OF THE P | | | | | | | | | PE | \$ 26 Mi |
| Alta | THRU TOWN OF ZUNI, BRIDGE OVER THE BLACKWATER RIVER BETWEEN ZUNI BYPASS AND WINDSOR BYPASS | Arc= 1 | 2 | 10 | _ | - | _ | Docidenti-I | 10 | ENIV/ | Ć 11 F 41 |
| Alts | · · | Area 1 | 3 | 10 | 2 | | 0 | Residential | 16 | ENV | \$ 11 M |
| 2s/4/1 | BETWEEN ZUNI BYPASS AND WINDSOR BYPASS BYPASS SOUTH OF WINDSOR EAST OF WINDSOR TO EASTERN TERMINUS ALONG NEW ALIGNMENT | Area 1 Area 2 | 3 | 10 0 | 2 | C | 0 | Commercial | 4 | UTIL | \$ 27 M |
| | BETWEEN ZUNI BYPASS AND WINDSOR BYPASS BYPASS SOUTH OF WINDSOR | | 3 3 102 | 10 0 6 | 2 0 2 | 0 0 | 0 0 | | | | \$ 11 M \$ 27 M \$ 23 M \$ 65 M |

Appendix C

Opinion of Probable Cost and Cost Development Methodology

OPINION OF PROBABLE COST ROUTE 460 SEVA

PREFERRED ALTERNATIVE DESIGN CORRIDOR SUMMARY OF PAY ITEM CATEGORIES

| PAY ITEM CATEGORY NUMBER | PAY ITEM CATEGORY | ITEM COST OPINION | | | | | | |
|--------------------------------|---|----------------------|--|--|--|--|--|--|
| 1 | SITEWORK / DEMOLITION PAY ITEMS | \$5,360,881.00 | | | | | | |
| 2 | EARTHWORK PAY ITEMS | \$68,656,720.00 | | | | | | |
| 3 | PAVEMENT, DRIVEWAYS & CURBS PAY ITEMS | \$56,796,133.00 | | | | | | |
| 4 | PERMANENT BARRIERS, GUARDRAIL & FENCING PAY ITEMS | \$4,441,864.00 | | | | | | |
| 5 | TRAFFIC | \$2,851,790.00 | | | | | | |
| 6 | LIGHTING AND ITS | \$5,606,830.00 | | | | | | |
| 7 | DRAINAGE PAY ITEMS | \$19,292,761.00 | | | | | | |
| 8 | STRUCTURE PAY ITEMS | \$88,128,061.00 | | | | | | |
| 9 | E&S (0.5%) | \$1,255,676.00 | | | | | | |
| 10 | MAINTENANCE OF TRAFFIC (8%) | \$20,191,258.00 | | | | | | |
| | TOTAL QUANTIFIED COSTS (Items 1 - 10) | \$272,581,974.00 | | | | | | |
| 11 | RAW CONSTRUCTION BASED COST | | | | | | | |
| 11a | CEI (10%) | \$27,258,198.00 | | | | | | |
| 11b | Mobilization (5%) | \$13,629,099.00 | | | | | | |
| 11c | PE (10%) | \$27,258,198.00 | | | | | | |
| 11d | Contingency (20%) | \$54,516,395.00 | | | | | | |
| | TOTAL RAW CONSTRUCTION BASED COSTS (Item 11) | \$122,661,890.00 | | | | | | |
| 12 | RIGHT-OF-WAY | \$22,000,000.00 | | | | | | |
| 13 | UTILITY | \$17,000,000.00 | | | | | | |
| 14 | ENVIRONMENTAL MITIGATION | \$13,000,000.00 | | | | | | |
| | TOTAL PROJECT COSTS (NOT IN CONSTRUCTION COSTS) (Items 12-14) | \$52,000,000.00 | | | | | | |
| | GRAND TOTAL COST OPINION ROUTE 460 SEVA PREFERRED ALTERNATIVE \$447,243,864.00 | | | | | | | |

| | | | TOT | AL CATEGORY COST | \$5,360,881.00 | 100% |
|-----------------------------|---|--------------------|-------------|---|----------------|-------------|
| | | | | | | |
| | | | | | | |
| | | Total | 72384.29 | \$5.00 | \$361,921.43 | 6.75% |
| 775+00 - ET (KHA) | | Tatal | 26,198 | ĆE OO | 6264 024 42 | C 750 |
| 180+90 - 775+00 | | | 46,186 | | | |
| Location | Bridge Width (FT) | Bridge Length (FT) | Area (SF) | Cost/Sq. Ft. | Cost | % of Total |
| 70500 NS DEMO/ | OF BLDG. (DEMOLIT | ION OF BUILDING) | | | | |
| | | | | | | |
| District Average sh | ows LS as Pay Unit, 1 | L LS | 1 | \$910,231.46 | \$910,231.46 | 16.98% |
| | | | 22,756 | \$40.00 | | |
| Murphys Mill Bridg | e (KHA) | | 8,800 | | | |
| Blackwater Bridge | | | 13,956 | | | |
| Location | Bridge Width (FT) | Bridge Length (FT) | Area (SF) | Cost/Sq. Ft. | Cost | % of Total |
| 67900 NS DISM. & | REM. EXIST. STR. (D | EMOLITION OF BRID | OGE) | | | |
| | | Total | 182,082 | \$5.00 | \$910,407.92 | 16.98% |
| 775+00 - ET (KHA) | | | 10,740 | | | |
| 180+90 - 775+00 | | 1,542,074 | 171,342 | , , | | |
| 24430 DEMOLITIO Location | <mark>N OF PAVEMENT (FL</mark> | .EXIBLE) Area (SF) | Area (SY) | Cost/Sq. Yd. | Cost | % of Total |
| | | | 373.32 | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | \$3,170,320.00 | 33.237 |
| | | Total | 373.92 | \$8,500.00 | \$3,178,320.00 | 59.29% |
| 775+00 - ET (KHA) | | | 149.00 | | | |
| 180+90 - 775+00 | Widen (11) | zenger (r r) | 224.92 | Cosqricic | Cost | 70 01 10tai |
| 00111 CLEARING A | Width (FT) | Length (FT) | Area (Acre) | Cost/Acre | Cost | % of Total |
| | | | | | | |
| SITEWORK / DEN | OLITION PAY ITEN | ИS | | | | |
| 300 W. | 0400 707 700, 100432 | NO. | | | | |
| Job #: | Minimization Design 0460-969-703, 100432 | No: | | | | |
| Task: | Avoidance and | Page: | | of: | | |
| Subject: | Cost Opinion | Checked: | MSS | Date: | 10/23/2015 | |
| Project: | Route 460 SEVA Preferred Alternative | Computed: | DB | Date: | 10/1/2015 | |

| Project: | Route 460 SEVA | Computed: | AZ/DB/SP | Date: | 10/1/2015 | | |
|------------------|-----------------------|-----------------|--------------|------------------|--------------|-----------------|----------------|
| | Preferred Alternative | | AZ/DD/3P | | 10/1/2015 | | |
| | Cost Opinion | | MSS | | 10/23/2015 | | |
| Subject: | | Checked: | IVISS | Date: | 10/23/2013 | | |
| Task: | Avoidance and | Page: | | of: | | | |
| | Minimization Design | -9 | | | | | |
| Job #: | 0460-969-703, 100432 | No: | | | | | |
| | • | | | | | | |
| EARTHIN ORK DAY | V ITENAC | | | | | | |
| EARTHWORK PA | YTTEMS | | | | | | |
| | | | | | | | |
| 00140 BORROW EX | KCAVATION (FILL) | T strat Continu | l | | | | |
| | La catta c | Typical Section | Construction |) (a) (C)() | C1/C V-1 | 01 | 0/ - (= 1 - 1 |
| | Location | End Area | Length (LF) | Volume (CY) | Cost/Cu. Yd. | Cost | % of Total |
| | Davita 400 | (Sq. Ft.) | | 2 702 022 | | | |
| | Route 460 | | | 2,793,023 109 | | | |
| | SR 664 Fire Tower | | | | | | |
| | SR 645 Yellow Ham | imer | | 720 | | | |
| | SR 639 Winston | | | 2,064 | | | |
| | SR 638 460W Conn | | | 16,884 | | | |
| | Ex. Route 460 | | | 104 | | | |
| | 460-Ramp A | | | 11,735 | | | |
| | 460-Ramp B | | | 13,084 | | | |
| | 460-Ramp C | | | 2,944 | | | |
| | 460-Ramp D | | | 15,007 | | | |
| | 460-Ramp E | | | 0 | | | |
| | Fill Required for Ex | | | 175,167 | | | |
| | Less Pavement Sec | | | -303,417 | | | |
| | Less Regular Excav | | | -110,337 | | | |
| | Less for MSE Select | | | -89,323 | | | |
| | Less for Light Weig | ht Embankment | | -214,607 | | | |
| | Sub Total (HDR) | | | 2,313,156 | | | |
| | Sub Total 775+00 - | | | 948,369 | | | |
| | Sub Total (Combine | ed) | | 3,261,525 | | | |
| | Shrinkage Factor (1 | 12%) | | 391,383 | | | |
| | | | | | | | |
| | | | Total | 3,652,908 | \$6.00 | \$21,917,450.46 | 31.92% |
| | | | | | | | |
| 00120 REGULAR EX | KCAVATION | | | | | | |
| | | Typical Section | | | | | |
| | Location | End Area | Construction | Volume (CY) | Cost/Cu. Yd. | Cost | % of Total |
| | | (Sq. Ft.) | Length (LF) | , , | | | |
| | Route 460 | | | 111,926 | | | |
| | SR 664 Fire Tower | | | 850 | | | |
| | SR 645 Yellow Ham | nmer | | 172 | | | |
| | SR 639 Winston | | | 1,683 | | | |
| | SR 638 460W Conn | | | 3,277 | | | |
| | Ex. Route 460 | | | 27,362 | | | |
| | 460-Ramp A | | | 2,598 | | | |
| | 460-Ramp B | | | 4,249 | | | |
| | 460-Ramp C | | | 2,249 | | | |
| | 460-Ramp D | | | 1,272 | | | |
| | 460-Ramp E | | | 491 | | | |
| | Drainage (SWMP, I | Ditch) | | 64,545 | | | |
| | Sub Total (HDR) | | | 220,674 | | | |
| | Sub Total 775+00 - | ET (KHV) | | 113,491 | | | |
| | 300 TOTAL 7/3+00 - | LI (KHA) | | 115,491 | | | |
| | | | | | | | |
| - | | | | | | | |
| <u> </u> | | | Tatal | 224.465 | 67.50 | ¢2 F0C 227 F0 | 2.050/ |
| | | | Total | 334,165 | \$7.50 | \$2,506,237.50 | 3.65% |
| I | | <u>l</u> | | | | | |

| Project: | Route 460 SEVA Preferred Alternative | Computed: | AZ/DB/SP | Date: | 10/1/2015 | | |
|------------------|---|--------------------------|-----------------------------------|----------------------------|-------------|----------------|------------|
| Subject: | Cost Opinion | Checked: | MSS | Date: | 10/23/2015 | | |
| Task: | Avoidance and Minimization Design | Page: | | of: | | | |
| Job #: | 0460-969-703, 100432 | No: | | | | | |
| | | | | | | | |
| EARTHWORK PAY | Y ITEMS | | | | | | |
| | | | | | | | |
| 27250 LIME | | l | l | I | I | | |
| | 10% Embankment Volume To Be Treated (Cu. Ft.) | 7 Months of 12 Months | Application Rate (lbs/Cu. Ft.) | Volume (Ton) | Cost/Ton | Cost | % of Total |
| | 9,862,853 | 0.5833 | 5 | 14,383 | \$263.00 | \$3,782,814.96 | 5.51% |
| | | | | | | | |
| 00128 EXTRA EXCA | VATION (UNDERCU | T) | | | | | |
| | | | | | | | |
| Treatment Type | Classification | Depth of Undercut | Backfill Material | Undercut Area (Sq. Ft.) | Volume (CF) | Cost | % of Total |
| 1 | Open Water/Pond (E) | 3.0' | VDOT No. 2 or 3 | 43022.82 | 129068.46 | | |
| 1 | Open Water/Pond (E) | 3.0' | VDOT No. 2 or 3 | 43250.09 | 129750.27 | | |
| 2 | Wetlands (D) | 2.0' | Select Material | 324392.06 | 648784.11 | | |
| 2 | Wetlands (D) | 2.0' | Select Material | 326105.68 | 652211.36 | | |
| 3 | Wooded, Non- wetland (C), < 10' Emb | 2.0' | Embankment | 1042983.64 | 2085967.27 | | |
| 3 | Wooded, Non- wetland (C), < 10' Emb | 2.0' | Embankment | 1057613.09 | 2115226.18 | | |
| 4 | Wooded, Non- wetland (C) > 10' Emb | 0.0' | Embankment | , | , | | |
| 5 | Cultivated Fields (B) < 10' Emb | 1.5' | Embankment | 1762361.28 | 2643541.92 | | |
| 5 | Cultivated Fields (B) < 10' Emb | 1.5' | Embankment | 1787081.12 | 2680621.68 | | |
| 6 | Cultivated Fields (B) > 10' Emb | 0.0' | Embankment | | | | |
| 7 | Developed (A) < 5' Emb | 0.0' | Embankment | | | | |
| 8 | Developed (A) > 5' Emb | 0.0' | Embankment | | | | |
| | | | | Total | 11085171.25 | | |
| | | | | Total (CY) | 410561.90 | | |
| | | | | | \$15.00 | \$6,158,428.47 | 8.97% |
| | i . | l . | I | 1 | 1 | i l | |

| r= | T- | T | l | I= - | T | • | |
|-------------------------------|---|--|------------------------|------------------|------------------|----------------|-------------|
| Project: | Route 460 SEVA Preferred Alternative | Computed: | AZ/DB/SP | Date: | 10/1/2015 | | |
| Subject: | Cost Opinion | Checked: | MSS | Date: | 10/23/2015 | | |
| Task: | Avoidance and Minimization Design | Page: | | of: | | | |
| Job #: | 0460-969-703, 100432 | No: | | | | | |
| EARTHWORK PA | Y ITEMS | | | | | | |
| VDOT Aggregate N | io 3 | | | | | | |
| Location | | Application Rate (lbs/CF) | Volume (CF) | TON | Cost/Ton | Cost | % of Total |
| 180+90 to 775+00 | | (IDS/CF) | 129068.46 | | | | |
| 776+00 - ET (KHA) | | | 129750.27 | | | | |
| | | 110 | 258818.73 | 14,235 | \$28.00 | \$398,580.84 | 0.58% |
| | | | | | | | |
| 00000 | 1.170.000 | | | | | | |
| UU282 Select Mate | <mark>rial TY. II Min. CBR-</mark> | | l | | | | |
| | | Application Rate (lbs/CF) | Volume (CF) | CY | Cost/CY | Cost | % of Total |
| 180+90 to 775+00 | | | 648784.11 | | | | |
| 776+00 - ET (KHA) | | 405 | 652211.36 | 40.405 | Ć10.00 | 4045 545 00 | 4 000/ |
| | | 135 | 1300995.47 | 48,185 | \$19.00 | \$915,515.33 | 1.33% |
| | | | | | | | |
| 00140 BORROW EX | CAVATION (FILL) | | l . | | | | |
| | | Extra Excavation Volume To Be Replaced | | Volume (CY) | Cost/Cu. Yd. | Cost | % of Total |
| | | (Cu. Ft.) | | | | | |
| Paid per Borrow Ex | ccavation (00140), s | ee above | | 175,167 | | | 0.00% |
| Prefabricated Vert | ical Drains (PVDs) | | | | | | |
| Location | Required Area (SF) | Contributory Area | | PVDs Length (LF) | Cost/LF | Cost | % of Total |
| 180+90 to 776+00 | | (SF) | | 907,159 | | | |
| 776+00 - ET (KHA) | | | | 147,806 | | | |
| ET (KHA) | | | | 295,612 | | | |
| Total | | | | 1,350,577 | \$0.75 | \$1,012,932.75 | 1.48% |
| | | | | | | . , , . | |
| 00504 Bed. Mat. F | <mark>ine Agr. Or Aggr. N</mark> o | o. 8 (Aggregate Mat | | | Application Rate | | bs/CF |
| Location | | Required Area (SF) | Average Thickness (LF) | Tons | lbs/CF | Cost | % of Total |
| 180+90 to 776+00 | | | | 45,172 | 115 | | |
| 776+00 - ET (KHA) ET (KHA) | | | | 7,360 14,720 | | | |
| | | | | | Cost/TON | | |
| Total | | | | 67,252 | \$20.00 | \$1,345,040.00 | 1.96% |
| 00400 6 | | | | | | | |
| Location | lacement & Remov | Required Area | Average Thickness | Cubic Yards (CY) | Cost/CY | Cost | % of Total |
| 180+90 to 776+00 | | (SF) | (LF) | 56,267 | COSI/CT | Cost | 70 OI TULAI |
| 776+00 - ET (KHA) | | | | 11,852 | | | |
| ET (KHA) | | | | 23,704 | | | |
| Total | | | | 91,823 | \$6.00 | \$550,938.00 | 0.80% |
| | | | | | | | |

| Project: | Route 460 SEVA Preferred Alternative | Computed: | AZ/DB/SP | Date: | 10/1/2015 | | |
|---------------------------------------|---|----------------------|--------------------|----------------------------|---------------------------|-----------------|------------|
| Subject: | Cost Opinion | Checked: | MSS | Date: | 10/23/2015 | | |
| Task: | Avoidance and Minimization Design | Page: | | of: | | | |
| Job #: | 0460-969-703, 100432 | No: | | | | | |
| | · | | | | | | |
| EARTHWORK PAY | / ITEMS | | | | | | |
| NS Light Weight Er | <mark>mbankment - NS No</mark> | .57 Stone | | | Application Rate | | lbs/CF |
| Location | | Volume (CY) | Volume (CF) | Tons | lbs/CF | Cost | % of Total |
| 180+90 to 776+00 776+00 - ET (KHA) | | 126628 63996 | 3418956 1727892 | 175,221 88,554 | 102.5 | | |
| ET (KHA) | | 90750 | 2450250 | 125,575 | | | |
| | | | | | Cost/TON | | |
| Total | | | | 389,351 | \$32.00 | \$12,459,240.72 | 18.15% |
| NS Liaht Weiaht Er | nbankment -Expand | ded Shale Aaareaat | e (ESA) | | Application Rate | | lbs/CF |
| Location | | Volume (CY) | Volume (CF) | Tons | lbs/CF | Cost | % of Total |
| 180+90 to 776+00 | | 87979 | 2375433 | 77,202 | 65 | | |
| 776+00 - ET (KHA) ET (KHA) | | 0 103983 | 0 2807541 | 0 9 1,24 5 | | | |
| 2. () | | 103303 | 2007541 | 31,243 | Cost/TON | | |
| Total | | 473336 | | 168,447 | \$80.00 | \$13,475,732.40 | 19.63% |
| | ow Excavation (001 | | | | | | |
| Light Weight Emba | | 214607 | | | | | |
| NO STABILIZATION | TABRIC | | | | | | |
| | | | | | | | |
| Treatment Type | Classification | Depth of Undercut | Backfill Material | Undercut Area (Sq. Ft.) | Coverage Area (Sq. Ft) | Cost | % of Total |
| 1 | Open Water/Pond (E) | 3.0' | VDOT No. 2 or 3 | 43022.82 | 43022.82 | | |
| 1 | Open Water/Pond (E) | 3.0' | VDOT No. 2 or 3 | 43250.09 | 43250.09 | | |
| 2 | Wetlands (D) | 2.0' | Select Material | 324392.06 | 324392.06 | | |
| 2 | Wetlands (D) | 2.0' | Select Material | 326105.68 | 326105.68 | | |
| 3 | Wooded, Non- wetland (C), < 10' Emb | 2.0' | Embankment | 1042983.64 | 1042983.64 | | |
| 3 | Wooded, Non- wetland (C), < 10' Emb | 2.0' | Embankment | 1057613.09 | 1057613.09 | | |
| 4 | Wooded, Non- wetland (C) > 10' Emb | 0.0' | Embankment | 660217.22 | 660217.22 | | |
| 4 | Wooded, Non- wetland (C) > 10' Emb | 0.0' | Embankment | 390381.87 | 390381.87 | | |
| 5 | Cultivated Fields (B) < 10' Emb | 1.5' | Embankment | 1762361.28 | 1762361.28 | | |
| 5 | Cultivated Fields (B) < 10' Emb | 1.5' | Embankment | 1787081.12 | 1787081.12 | | |
| 6 | Cultivated Fields (B) > 10' Emb | 0.0' | Embankment | 1115589.18 | 1115589.18 | | |
| 6 | Cultivated Fields (B) > 10' Emb | 0.0' | Embankment | 659640.16 | 659640.16 | | |
| 7 | Developed (A) < 5' Emb | 0.0' | Embankment | | | | |
| 8 | Developed (A) > 5' Emb | 0.0' | Embankment | | | | |
| | LIII | | | Total | 9212638.21 | | |
| | | | | Total (SY) | 1023626.47 | | |
| | | | · | | \$4.00 | \$4,094,505.87 | 5.96% |
| | | | | | | | |

| Project: | Route 460 SEVA | Computed: | AZ/DB/SP | Date: | 10/1/2015 | | |
|------------------|---|----------------------|-------------------|----------------------------|------------------------|-----------------|------------|
| | Preferred Alternative | | AZIDBISI | | 10/1/2013 | | |
| Subject: | Cost Opinion | Checked: | MSS | Date: | 10/23/2015 | | |
| Task: | Avoidance and Minimization Design | Page: | | of: | | | |
| Job #: | 0460-969-703, 100432 | No: | | | | | |
| | | | | | | | |
| EARTHWORK PAY | Y ITEMS | | | | | | |
| | | | | | | | |
| NS FILTER FABRIC | I | l | I | 1 | | 1 | |
| | | | | | | | |
| Treatment Type | Classification | Depth of Undercut | Backfill Material | Undercut Area (Sq. Ft.) | Coverage Area (Sq. Ft) | Cost | % of Total |
| 1 | Open Water/Pond (E) | 3.0' | VDOT No. 2 or 3 | 43022.82 | 88196.78 | | |
| 1 | Open Water/Pond (E) | 3.0' | VDOT No. 2 or 3 | 43250.09 | 88662.68 | | |
| 2 | Wetlands (D) | 2.0' | Select Material | | | , | |
| 3 | Wooded, Non- wetland (C), < 10' Emb | 2.0' | Embankment | | | | |
| 4 | Wooded, Non- wetland (C) > 10' Emb | 0.0' | Embankment | | | | |
| 5 | Cultivated Fields (B) < 10' Emb | 1.5' | Embankment | | | | |
| 6 | Cultivated Fields (B) > 10' Emb | 0.0' | Embankment | | | | |
| 7 | Developed (A) < 5' Emb | 0.0' | Embankment | | | | |
| 8 | Developed (A) > 5' Emb | 0.0' | Embankment | | | | |
| | | | | Total | 176859.46 | | |
| | | | | Total (SY) | 19651.05 | | |
| | | | | | \$2.00 | \$39,302.10 | 0.06% |
| | | | | | | | |
| | | | | | TOTAL CATEGORY COST | \$68,656,720.00 | 100.00% |
| | | | | | | | |

| Project: | Route 460 SEVA | Computed: | DB/JW | Date: | 10/1/2015 | | | | |
|--|---|--|------------------------------------|--|--|--|------------|----------------|-------------------|
| | Preferred Alternative | | DB/JW | | 10/1/2015 | | | | |
| | Cost Opinion | | MSS | | 10/23/2015 | | | | |
| Subject: | | Checked: | IVISS | Date: | 10/23/2013 | | | | |
| Task: | Avoidance and | Page: | | of: | | | | | |
| T GLON. | Minimization Design | r ago. | | o., | | | | | |
| Job #: | 0460-969-703, 100432 | No: | | | | | | | |
| 300 1. | 0400-707-703, 100432 | 110. | | | | | | | |
| | | | | | | | | | |
| PAVEMENT, DRIVE | WAYS & CURBS P | AY ITEMS | | | | | | | |
| | | | | | | | | | |
| 16350 ASPHALT CON | ICRETE, TY. SM-12.5 | 5A | Mainline Shoulder | ; Primary, Ramps, ai | nd Secondary Trave | l Lane and Shoulder | | | |
| Location | Typical Section | Construction | Depth (IN) | Volume (SY*IN) | App. Rate | Weight (Ton) | Cost/Ton | Cost | % of Total |
| Location | Width (FT) | Length (LF) | Deptil (IIV) | volume (51 m) | (LBS/SY*IN) | weight (1011) | COST/ TOTI | COST | 70 OI 10tai |
| Typical Section A (Shld) | 26 | 23052.96 | 2 | 133194.88 | 110 | 7,326 | | | |
| Typical Section B (Shld) | 26 | 8319.00 | 2 | 48065.33 | 110 | 2,644 | | | |
| Typical Section C (Shld) | 40 | 4683.95 | 2 | 41635.11 | 110 | 2,290 | | | |
| Typical Section D (Shld) | 0 | 1615.02 | 2 | 0.00 | 110 | 0 | | | |
| Typical Section E (Shld) | 18 | 3500.00 | 2 | 14000.00 | 110 | 770 | | | |
| Additional Area (SF) | | 296322.12 | 2 | 65849.36 | 110 | 3,622 | | | |
| Ramps and Primary Route | es | 314559.04 | 2 | 69902.01 | 110 | 3,845 | | | |
| Secondary Routes | | 124315.21 | 2 | 27625.60 | 110 | 1,519 | | | |
| 775+00 - ET (KHA), R and | P | 1331162.51 | 2 | 295813.89 | 110 | 16,270 | | | |
| (,, dild | | | 2 | 0.00 | 110 | 0 | | | |
| | | | | 5.50 | 110 | - | | + | |
| | | 1 | 1 | 1 | Total | 38,285 | \$77.00 | \$2,947,925.00 | 5.19% |
| | | | | | Total | 38,283 | V | \$2,547,525.00 | 3.13/0 |
| 16360 Asphalt Cons | roto TV CM 12 FF | | Mainline Travel La | | | | | | |
| 16360 Asphalt Conci | 1 | C | Iviainiine Travel La | l | A D-t- | | | 1 | |
| Location | Typical Section | Construction | Depth (IN) | Volume (SY*IN) | App. Rate | Weight (Ton) | | Cost | % of Total |
| Total Continue A (TI) | Width (FT) | Length (LF) 23052.96 | 2 | 245000.24 | (LBS/SY*IN) | 12.524 | | | |
| Typical Section A (TL) | 48 | | 2 | 245898.24 88736.00 | 110 | 13,524 | | | |
| Typical Section B (TL) | 48 | 8319.00 | 2 | | 110 | 4,880 | | | |
| Typical Section C (TL) | 48 | 4683.95 | 2 | 49962.13 | 110 | 2,748 | | | |
| Typical Section D (TL) | 71 | 1615.02 | 2 | 25481.43 | 110 | 1,401 | | | |
| Typical Section E (TL) | 66 | 3500.00 | 2 | 51333.33 | 110 | 2,823 | | | |
| Additional Area (SF) | | 950963.88 | 2 | 211325.31 | 110 | 11,623 | | | |
| 775+00 - ET (KHA), SI | F | 1127876.64 | 2 | 250639.25 | 110 | 13,785 | | | |
| | | | | | | | | | |
| | | | | | Total | 50,786 | \$95.00 | \$4,824,638.00 | 8.49% |
| | | | | | | | | | |
| 10610 Asphalt Conci | ete, TY. IM-19.0A | | Mainline Shoulder | ; Primary & Ramps 1 | Travel Lane and Sho | oulder | | | |
| | Typical Section | Construction | | (0 | App. Rate | | | | |
| Location | Width (FT) | Length (LF) | Depth (IN) | Volume (SY*IN) | (LBS/SY*IN) | Weight (Ton) | Cost/Ton | Cost | % of Total |
| Typical Section A (ShId) | 26 | 23052.96 | 2 | 133194.88 | 110 | 7,326 | | | |
| Typical Section B (Shld) | 26 | 8319.00 | 2 | 48065.33 | 110 | 2,644 | | | |
| Typical Section C (Shld) | 40 | 4683.95 | 2 | 41635.11 | 110 | 2,290 | | | |
| Typical Section D (Shld) | 0 | 1615.02 | 2 | 0.00 | 110 | 0 | | + | |
| Typical Section E (ShId) | 18 | 3500.00 | 2 | 14000.00 | 110 | 770 | | | |
| Additional Area (SF) | 10 | 296322.12 | 2 | 65849.36 | 110 | 3,622 | | | |
| Ramps and Primary F | Poutes | 314559.04 | 2 | 69902.01 | 110 | 3,845 | | | |
| | | 1187855.41 | 2 | 263967.87 | 110 | 14,518 | | | |
| 775+00 - ET (KHA), SI | | 110/000.41 | | 203507.87 | 110 | 14,310 | | | |
| | | + | + | 1 | | 25.000 | 672.00 | 40.550.000 | |
| | | 1 | 1 | | Total | 35,014 | \$73.00 | \$2,556,007.46 | 4.50% |
| | | | | | | | | | |
| | | | | | | | | | |
| 10611 Asphalt Concr | l . | | Mainline Travel La | ne | | | | | |
| - | Typical Section | Construction | | | App. Rate | Weight (Ton) | Cost/Ton | Cost | % of Total |
| Location | Typical Section Width (FT) | Length (LF) | Depth (IN) | Volume (SY*IN) | (LBS/SY*IN) | Weight (Ton) | Cost/Ton | Cost | % of Total |
| Location Typical Section A (TL) | Typical Section Width (FT) 48 | Length (LF) 23052.96 | Depth (IN) | Volume (SY*IN) 245898.24 | (LBS/SY*IN) 110 | 13,524 | Cost/Ton | Cost | % of Total |
| Location Typical Section A (TL) Typical Section B (TL) | Typical Section Width (FT) 48 48 | Length (LF) 23052.96 8319.00 | Depth (IN) 2 2 | Volume (SY*IN) 245898.24 88736.00 | (LBS/SY*IN) 110 110 | 13,524 4,880 | Cost/Ton | Cost | % of Total |
| Location Typical Section A (TL) | Typical Section Width (FT) 48 48 48 | Length (LF) 23052.96 | Depth (IN) 2 2 2 | Volume (SY*IN) 245898.24 88736.00 49962.13 | (LBS/SY*IN) 110 110 110 | 13,524 | Cost/Ton | Cost | % of Total |
| Location Typical Section A (TL) Typical Section B (TL) | Typical Section Width (FT) 48 48 | Length (LF) 23052.96 8319.00 | Depth (IN) 2 2 | Volume (SY*IN) 245898.24 88736.00 | (LBS/SY*IN) 110 110 | 13,524 4,880 | Cost/Ton | Cost | % of Total |
| Location Typical Section A (TL) Typical Section B (TL) Typical Section C (TL) | Typical Section Width (FT) 48 48 48 | Length (LF) 23052.96 8319.00 4683.95 | Depth (IN) 2 2 2 | Volume (SY*IN) 245898.24 88736.00 49962.13 | (LBS/SY*IN) 110 110 110 | 13,524 4,880 2,748 | Cost/Ton | Cost | % of Total |
| Location Typical Section A (TL) Typical Section B (TL) Typical Section C (TL) Typical Section D (TL) | Typical Section Width (FT) 48 48 48 71 66 | Length (LF) 23052.96 8319.00 4683.95 1615.02 | Depth (IN) 2 2 2 2 2 | Volume (SY*IN) 245898.24 88736.00 49962.13 25481.43 | (LBS/SY*IN) 110 110 110 110 | 13,524 4,880 2,748 1,401 | Cost/Ton | Cost | % of Total |
| Location Typical Section A (TL) Typical Section B (TL) Typical Section C (TL) Typical Section D (TL) Typical Section E (TL) | Typical Section Width (FT) 48 48 48 71 66 | Length (LF) 23052.96 8319.00 4683.95 1615.02 3500.00 | Depth (IN) 2 2 2 2 2 2 2 | Volume (SY*IN) 245898.24 88736.00 49962.13 25481.43 51333.33 | (LBS/SY*IN) 110 110 110 110 110 110 110 | 13,524 4,880 2,748 1,401 2,823 | Cost/Ton | Cost | % of Total |
| Location Typical Section A (TL) Typical Section B (TL) Typical Section C (TL) Typical Section D (TL) Typical Section E (TL) Additional Area (SF) | Typical Section Width (FT) 48 48 48 71 66 | Length (LF) 23052.96 8319.00 4683.95 1615.02 3500.00 950963.88 | Depth (IN) 2 2 2 2 2 2 2 2 | Volume (SY*IN) 245898.24 88736.00 49962.13 25481.43 51333.33 211325.31 | (LBS/SY*IN) 110 110 110 110 110 110 110 1 | 13,524 4,880 2,748 1,401 2,823 11,623 | Cost/Ton | Cost | % of Total |
| Location Typical Section A (TL) Typical Section B (TL) Typical Section C (TL) Typical Section D (TL) Typical Section E (TL) Additional Area (SF) | Typical Section Width (FT) 48 48 48 71 66 | Length (LF) 23052.96 8319.00 4683.95 1615.02 3500.00 950963.88 | Depth (IN) 2 2 2 2 2 2 2 2 | Volume (SY*IN) 245898.24 88736.00 49962.13 25481.43 51333.33 211325.31 | (LBS/SY*IN) 110 110 110 110 110 110 110 110 110 11 | 13,524 4,880 2,748 1,401 2,823 11,623 13,785 | | | % of Total 7.96% |
| Location Typical Section A (TL) Typical Section B (TL) Typical Section C (TL) Typical Section D (TL) Typical Section E (TL) Additional Area (SF) | Typical Section Width (FT) 48 48 48 71 66 | Length (LF) 23052.96 8319.00 4683.95 1615.02 3500.00 950963.88 | Depth (IN) 2 2 2 2 2 2 2 2 | Volume (SY*IN) 245898.24 88736.00 49962.13 25481.43 51333.33 211325.31 | (LBS/SY*IN) 110 110 110 110 110 110 110 1 | 13,524 4,880 2,748 1,401 2,823 11,623 | Cost/Ton | Cost | |

| | T | To | | In . | T | , | ī | | |
|--------------------------|---|-----------------------------|--------------------------|---------------------------------------|--------------------------|--------------|----------|---|------------|
| Project: | Route 460 SEVA Preferred Alternative | Computed: | DB/JW | Date: | 10/1/2015 | | | | |
| Subject: | Cost Opinion | Checked: | MSS | Date: | 10/23/2015 | | | | |
| Task: | Avoidance and Minimization Design | Page: | | of: | | | | | |
| Job #: | 0460-969-703, 100432 | No: | | | | | | | |
| PAVEMENT, DRIVE | WAYS & CURRS P | AY ITEMS | | | | | | | |
| TAVEIVIENT, DICIVE | WATS & CORDST | AT TIENIS | | | | | | | |
| 10642 Asphalt Conc | rete, TY. BM-25.0A | | Mainline Shoulder | <mark>r; Primary & Ramps o</mark> | and Secondary Trav | el Lane | | | |
| Location | | Construction Area (SF) | Depth (IN) | Volume (SY*IN) | App. Rate (LBS/SY*IN) | Weight (Ton) | Cost/Ton | Cost | % of Total |
| Typical Section A (ShId) | 26 | 23052.96 | 3 | 199792.32 | 110 | 10,989 | | | |
| Typical Section B (Shld) | 26 | 8319.00 | 3 | 72098.00 | 110 | 3,965 | | | |
| Typical Section C (Shld) | 40 | 4683.95 | 3 | 62452.67 | 110 | 3,435 | | | |
| Typical Section D (Shld) | 0 | 1615.02 | 3 | 0.00 | 110 | 0 | | | |
| Typical Section E (Shld) | 18 | 3500.00 | 3 | 21000.00 | 110 | 1,155 | | | |
| Additional Area (SF) | | 296322.12 | 3 | 98774.04 | 110 | 5,433 | | | |
| Ramps and Primary I | Routes | 229467.89 | 5 | 127482.16 | 110 | 7,012 | | | |
| Secondary Routes | | 105364.78 | 3 | 35121.59 | 110 | 1,932 | | | |
| 775+00 - ET (KHA), N | ΛL Shld | 599509.41 | 3 | 199836.47 | 110 | 10,991 | | | |
| 775+00 - ET (KHA), R | | 380800.00 | 5 | 211555.56 | 110 | 11,636 | | | |
| 775+00 - ET (KHA), S | | 143307.10 | 3 | 47769.03 | 110 | 2,627 | | | |
| (// - | | | | | | , | | | |
| | | | | | Total | 59,174 | \$78.00 | \$4,615,533.09 | 8.13% |
| | | | | | | | , | , ,, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | |
| 10643 Asphalt Conc | rete, TY. BM-25.0D | | Mainline Travel La | ine | | | | | |
| Location | Typical Section Width (FT) | Construction Length (LF) | Depth (IN) | Volume (SY*IN) | App. Rate (LBS/SY*IN) | Weight (Ton) | Cost/Ton | Cost | % of Total |
| Typical Section A (TL) | 48 | 23052.96 | 10 | 1229491.20 | 110 | 67,622 | | | |
| Typical Section B (TL) | 48 | 8319.00 | 10 | 443680.00 | 110 | 24,402 | | | |
| Typical Section C (TL) | 48 | 4683.95 | 10 | 249810.67 | 110 | 13,740 | | | |
| Typical Section D (TL) | 71 | 1615.02 | 10 | 127407.13 | 110 | 7,007 | | | |
| Typical Section E (TL) | 66 | 3500.00 | 10 | 256666.67 | 110 | 14,117 | | | |
| Additional Area (SF) | | 950963.88 | 10 | 1056626.53 | 110 | 58,114 | | | |
| 775+00 - ET (KHA), S | F | 1127876.64 | 10 | 1253196.27 | 110 | 68,926 | | | |
| | | | | | | | | | |
| | | | | | Total | 253,928 | \$78.00 | \$19,806,408.62 | 34.87% |
| | | | | | | | | | |
| Asphalt Stabilized O | pen-Graded Materi | al | Mainline Travel La | ine | | | | | |
| Location | Typical Section Width (FT) | Construction Length (LF) | Depth (IN) | Volume (SY*IN) | App. Rate (LBS/SY*IN) | Weight (Ton) | Cost/Ton | Cost | % of Total |
| Typical Section A (TL) | 48 | 23052.96 | 2 | 245898.24 | 85 | 10,451 | | | |
| Typical Section B (TL) | 48 | 8319.00 | 2 | 88736.00 | 85 | 3,771 | | | |
| Typical Section C (TL) | 48 | 4683.95 | 2 | 49962.13 | 85 | 2,123 | | | |
| Typical Section D (TL) | 71 | 1615.02 | 2 | 25481.43 | 85 | 1,083 | | | |
| Typical Section E (TL) | 66 | 3500.00 | 2 | 51333.33 | 85 | 2,182 | | | |
| Additional Area (SF) | | 950963.88 | 2 | 211325.31 | 85 | 8,981 | | | |
| 775+00 - ET (KHA), S | | 1127876.64 | 2 | 250639.25 | 85 | 10,652 | | | |
| | | | | | | | | | |
| | | | | | Total | 39,243 | \$80.00 | \$3,139,477.36 | 5.53% |
| | | | | | | | | | |
| | | | | | | | | | |

| Project: | Route 460 SEVA | Computed: | 1 | Date: | | 1 | | | |
|---|-------------------------|------------------------|--------------------|------------------------|-------------------|----------------------|-----------------|-----------------|-------------|
| Tojou. | Preferred Alternative | oompared. | DB/JW | Date: | 10/1/2015 | | | | |
| Publicat. | Cost Opinion | Checked: | MSS | Data | 10/23/2015 | | | | |
| Subject: | Avoidance and | | | Date: | | | | | |
| Task: | Minimization Design | Page: | | of: | | | | | |
| Job #: | 0460-969-703, 100432 | No: | | | | | | | |
| | | | | | | | | | |
| PAVEMENT, DRIVE | WAYS & CURBS P | AY ITEMS | | | | | | | |
| 10013 Cement Stabil | ized Aggregate Ma | terial No. 21A | Mainline Travel La | ine | | | | | |
| | Typical Section | Construction | | | App. Rate | | | | |
| Location | Width (FT) | Length (LF) | Depth (IN) | Volume (SY*IN) | (LBS/SY*IN) | Weight (Ton) | Cost/Ton | Cost | % of Total |
| Typical Section A (TL) | 48 | 23052.96 | 6 | 737694.72 | 100 | 36,885 | | | |
| Typical Section B (TL) Typical Section C (TL) | 48 48 | 8319.00 4683.95 | 6 | 266208.00 149886.40 | 100 100 | 13,310 7,494 | | | |
| Typical Section C (TL) | 71 | 1615.02 | 6 | 76444.28 | 100 | 3,822 | | | |
| Typical Section E (TL) | 66 | 3500.00 | 6 | 154000.00 | 100 | 7,700 | | | |
| Additional Area (SF) | | 950963.88 | 6 | 633975.92 | 100 | 31,699 | | | |
| 775+00 - ET (KHA), SF | | 1127876.64 | 6 | 751917.76 | 100 | 37,596 | | | |
| | | | | | | | | | |
| | | | | | Total | 138,506 | \$44.00 | \$6,094,279.58 | 10.73% |
| 10100 Aggregate Mo | aterial No. 21R | <u> </u> | Mainline Shoulder | and Ramp, Primary, | & Secondary Trave | el Lane and Shoulder | | | |
| | Typical Section | Construction | | | App. Rate | | | | |
| Location | Width (FT) | Length (LF) | Depth (IN) | Volume (SY*IN) | (LBS/SY*IN) | Weight (Ton) | Cost/Ton | Cost | % of Total |
| Typical Section A (ShId) | 26 | 23052.96 | 15 | 998961.60 | 105 | 52,445 | | | |
| Typical Section B (Shld) | 26 | 8319.00 | 15 | 360490.00 | 105 | 18,926 | | | |
| Typical Section C (Shld) | 40 | 4683.95 | 15 | 312263.33 | 105 | 16,394 | | | |
| Typical Section D (Shld) | 0 | 1615.02 | 15 | 0.00 | 105 | 0 | | | |
| Typical Section E (ShId) Additional Area (SF) | 18 | 3500.00 296322.12 | 15 15 | 105000.00 493870.19 | 105 105 | 5,513 25,928 | | | |
| Ramps and Primary R | outes TL (SF) | 229467.89 | 8 | 203971.46 | 105 | 10,709 | | | |
| Ramps and Primary R | | 85091.15 | 13 | 122909.44 | 105 | 6,453 | | | |
| Secondary Routes TL | | 105364.78 | 10 | 117071.98 | 105 | 6,146 | | | |
| Secondary Routes Sh | oulder (SF) | 18950.43 | 13 | 27372.84 | 105 | 1,437 | | | |
| 775+00 - ET (KHA), M | | 599509.41 | 15 | 999182.35 | 105 | 52,457 | | | |
| 775+00 - ET (KHA), R | | 380800.00 | 8 | 338488.89 | 105 | 17,771 | | | |
| 775+00 - ET (KHA), R 775+00 - ET (KHA), Se | | 207546.00 143307.10 | 13 11.5 | 299788.67 183114.63 | 105 105 | 15,739 9,614 | | | |
| 775+00 - ET (KHA), Se | | | 13 | 0.00 | 105 | 0 | | | |
| (| , , , , , , , , , , , , | | | | | - | | | |
| | | | | | Total | 239,530 | \$29.00 | \$6,946,383.98 | 12.239 |
| | | | | | | | | | |
| 12600 Standard Com | bination Curb & Gu | itter CG-6 | 1 | l., | | | | | |
| Location | | | | Number of Curb & | Construction | Length (LF) | Cost/LF | Cost | % of Total |
| 226+18.96 - 255+00.0 | OO (ZLINI) | | | Gutters | Length (LF) | 5,695 | | | |
| Murphy's Mill Conne | | | | | | 12,317 | | | |
| Existing Route 460 at | | | | | | 1,713 | | | |
| | | | | | | | | | |
| | | | | | Total | 19,725 | \$13.00 | \$256,429.94 | 0.459 |
| | | | | | | | | | |
| 13220 Hydraulic Cem | ent Concrete Sidou | valk 4" | | | | | | | |
| - | .c.n concrete sidev | | Number of | Construction | | | Cost/ | | |
| Location | | | Sidewalks | Length (LF) | Area (SF) | Area (SY) | Sq. Yd. | Cost | % of Total |
| 226+18.96 - 255+00.0 | , , | | | | 21308.4235 | 2,368 | · | | |
| Murphy's Mill Conne | ctor and General Ea | rly (KHA) | | | 42977 | 4,775 | | | |
| | | | | | | | A | Ann | |
| | | | | | Total | 7,143 | \$31.00 | \$221,427.57 | 0.399 |
| | | | | | | | | | |
| 21020 Median Strip I | MS-1 | | | | | | | | |
| • | | | | Construction | Area (CE) | Area (CV) | Cost/ | Co-t | 0/ of T-+-! |
| Location | | | | Length (LF) | Area (SF) | Area (SY) | Sq. Yd. | Cost | % of Total |
| 180+90 - 775+00 | | | | | 94473.03 | 10,497 | | | |
| Murphy's Mill Conne | ctor (KHA) | | | | 3143 | 349 | | | |
| | | | | | Total | 10046 3 | \$80.00 | \$867,698.04 | 1 520 |
| | | | | | Total | 10846.2 | 300,00 | 40.869,700¢ | 1.539 |
| | 1 | | | | | | | | |
| | | | | | | | | | |
| | | + | + | | | TOTA | L CATEGORY COST | \$56,796,133.00 | 100.009 |

| Project: | Route 460 SEVA Preferred Alternative | Computed: | DB | Date: | 10/1/2015 | | |
|--------------------------------------|--|---------------------------------|-----------------------------|------------------|------------|----------------|------------|
| Subject: | Cost Opinion | Checked: | MSS | Date: | 10/23/2015 | | |
| Task: | Avoidance and Minimization Design | Page: | | of: | | | |
| Job #: | | No: | | | | | |
| DEDBAANENT DAI | DDIEDE CHADDRA | IL O EENCINIC DAY | ITENAC | | | | |
| | | IL & FENCING PAY | I I EIVIS | | | | |
| 13460 Median Bar | rier MB-7D | Number of | | | | | |
| | Location | Concrete Median Barriers | Construction Length (LF) | Length (LF) | Cost/LF | Cost | % of Total |
| | 180+90 - 775+00 | | | 5,032 | | | |
| | 775+00 - ET (KHA) | | | 500 | | | |
| | | | Total | 5,532 | \$132.00 | \$730,158.00 | 16.44% |
| | | | | | | | |
| 13320 Guardrail, G | Number of | Percent of Langth | Construction | | | | |
| Location | Guardrail Runs | Percent of Length To Be Applied | Length (LF) | Length (LF) | Cost/LF | Cost | |
| 180+90 - 775+00 775+00 - ET (KHA) | Oddi di di ni | 10 507160 | 2011.611.(21.) | 60,702 47,267 | | | |
| | | | | 107.050 | Ć10.00 | 44.040.400.00 | 40 ===/ |
| | | | Total | 107,969 | \$18.00 | \$1,943,433.00 | 43.75% |
| 13392 Fixed Object | t Attachment GR-FO | A-2 TY. I (Run-On) | | | | | |
| Location | Frequency of FOAs (Lin. Ft.) | Construction Length (LF) | Number of FOAs | Number (EA) | Cost/Each | Cost | % of Total |
| 180+90 - 775+00 | | | | 47 | | | |
| 775+00 - ET (KHA) ET (KHA) | | | | 8 14 | | | |
| LI (KIIA) | | | | 14 | | | |
| | | | Total | 69 | \$2,250.00 | \$155,250.00 | 3.50% |
| 13393 Fixed Object | t Attachment GR-FO | A-2 TY. II (Run-Off) | | | | | |
| Location | Frequency of FOAs (Lin. Ft.) | | Number of FOAs | Number (EA) | Cost/Each | Cost | % of Total |
| 180+90 - 775+00 | , , | <u> </u> | | 41 | | | |
| 775+00 - ET (KHA) ET (KHA) | | | | 8 11 | | | |
| | | | Total | 60 | \$467.00 | \$28,020.00 | 0.63% |
| | | | | | | | |
| 13315 Guardrail To | The state of the s | | | | | | |
| Location | Frequency of Terminals (Lin. Ft.) | Construction Length (LF) | Number of Terminals | Number (EA) | Cost/Each | Cost | % of Total |
| 180+90 - 775+00 775+00 - ET (KHA) | (= | | | 44 43 | | | |
| | | | Total | | \$735.00 | ¢63.04F.00 | 1 440/ |
| | | | Total | 87 | \$755.00 | \$63,945.00 | 1.44% |
| 13345 Alt. Breaka | way Cable Terminal | (GR-9) (Guardrail Te | rminal) | | | | |
| Location | Frequency of Terminals (Lin. Ft.) | Construction Length (LF) | Number of Terminals | Number (EA) | Cost/Each | Cost | % of Total |
| 180+90 - 775+00 | (Enr. 1 C.) | | | 48 | | | |
| 775+00 - ET (KHA) | | | | 43 | | | |
| , , | | | | | | | |

| Project: | Route 460 SEVA | Computed: | 1 | Date: | | | |
|--------------------|--------------------------------------|-----------------------------|------------------------------------|-------------|------------------|----------------|------------|
| riojeci. | Preferred Alternative | Computed. | DB | Date. | 10/1/2015 | | |
| Subject: | Cost Opinion | Checked: | MSS | Date: | 10/23/2015 | | |
| Task: | Avoidance and Minimization Design | Page: | | of: | | | |
| Job #: | 0460-969-703, 100432 | No: | | | | | |
| | | | | | | | |
| PERMANENT BA | RRIERS, GUARDRA | IL & FENCING PAY | ITEMS | | | | |
| 12604 Impact Atta | nuators Service Ty. 1 | 1 /TI 2 \AE MADU) | | | | | |
| 13004 Impact Atte | Frequency of | (11-3, 243 WIFH) | | | 1 | | |
| Location | Attenuators (Lin. Ft.) | Construction Length (LF) | Number of Attenuators | Number (EA) | Cost/Each | Cost | % of Total |
| 180+90 - 775+00 | | | | 10 | | | |
| 775+00 - ET (KHA) | | | | 2 | | | |
| | | | Tatal | 42 | ća 000 00 | ¢00,000,00 | 2.450/ |
| | | | Total | 12 | \$8,000.00 | \$96,000.00 | 2.16% |
| 22501 Fence FE-W | 1 | | | | | | |
| 22301 Telle TE-W | _ | | | | | | |
| | Location | Number of Fences | Percent of Length To Be Applied | Length (LF) | Cost/LF | Cost | % of Total |
| | 180+90 - 775+00 | | | 83,839 | | | |
| | 775+00 - ET (KHA) | | | 60,918 | | | |
| | | | Tatal | 144757 | ća 00 | Ć4 450 052 2C | 26.070/ |
| | | | Total | 144,757 | \$8.00 | \$1,158,053.36 | 26.07% |
| 22541 Line Brace I | Jnit FE-W1, FE-W2 | | | | | | |
| LESTE LINE BIGGE | Frequency of Line | | | | | | |
| Location | Braces (Lin. Ft.) | Construction Length (LF) | Number of Fences | Number (EA) | Cost/Each | Cost | % of Total |
| 180+90 - 775+00 | 1 / 500 LF | 83,839 | | 168 | | | |
| 775+00 - ET (KHA) | 1 / 500 LF | 60918 | | 122 | | | |
| | | | | | 440.00 | * | |
| | | | Total | 290 | \$40.00 | \$11,580.53 | 0.26% |
| 22910 Gate FE-GL | I=16' | | | | | | |
| | Frequency of | Construction | | | | | |
| Location | Gates (Lin. Ft.) | Length (LF) | Number of Gates | Number (EA) | Cost/Each | Cost | % of Total |
| 180+90 - 775+00 | 1 / 5000 LF | 83,839 | | 17 | | | |
| SWMP | | | | 30 | | | |
| 775+00 - ET (KHA) | 1 / 5000 LF | 60918 | | 12 | | | |
| SWMP (KHA) | | | | 17 | | | |
| | | | Total | 76 | \$400.00 | \$30,380.53 | 0.68% |
| | | | Total | /0 | 3400.00 | \$50,380.53 | 0.08% |
| | | | | | | | |
| | | | | | | | |
| | | | | тот | AL CATEGORY COST | \$4,441,864.00 | 100.00% |

| Destroit | D + 4/0 051/4 | Ct-d | 1 | Dete | | | | |
|----------------------------------|---|-----------|-----------------|------------------------|---|---------|---|------------|
| Project: | Route 460 SEVA Preferred Alternative | Computed: | JW | Date: | 10/1/2015 | | | |
| | Cost Opinion | | | | | | | |
| Subject: | ооз ориноп | Checked: | DB | Date: | 10/23/2015 | | | |
| Task: | Avoidance and | Dogo | | of: | | | | |
| Task: | Minimization Design | Page: | | OI: | | | | |
| Job#: | 0460-969-703, 100432 | No: | | | | | | |
| PAVEMENT STRIPING, MARKING | G & SIGNING PAY IT | TEMS | | | | | | |
| | | | | | | | | |
| Pavement Striping | 1 | 1 | | | | | | |
| Location | | | Number of Paint | Construction | Length (LF) | Cost/LF | Cost | % of Total |
| Begin and Section C | 180+90.00 | 226+18.96 | Lines 6 | Length (LF) 4528.96 | 27,174 | | | |
| Section D | 226+18.96 | 255+00.00 | 4 | 2881.04 | 11,524 | | | |
| Sections A, B C, E, and F | 255+00.00 | 775+00.00 | 6 | 52000.00 | 312,000 | | | |
| SR664 Intersection | 244+60.00 | 247+15.00 | 2 | 255.00 | 510 | | | |
| SR664 Intersection | 249+15.00 | 252+00.00 | 2 | 285.00 | 570 | | | |
| SR664 Intersection | 57+65.00 | 60+86.40 | 3 | 321.40 | 964 | | | |
| SR664 Intersection | 62+75.50 | 68+00.00 | 3 | 524.50 | 1,574 | | | |
| SR645 Intersection | 304+40.00 | 309+50.00 | 2 | 510.00 | 1,020 | | | |
| SR645 Intersection | 311+30.00 | 315+85.00 | 2 | 455.00 | 910 | | | |
| SR645 Intersection | 58+45.00 | 60+75.00 | 3 | 230.00 | 690 | | | |
| SR645 Intersection | 62+20.00 | 65+20.00 | 3 | 300.00 | 900 | | | |
| SR639 Intersection | 377+80.00 | 383+30.00 | 1 | 550.00 | 550 | | | |
| SR639 Intersection | 384+45.00 | 388+70.00 | 1 | 425.00 | 425 | | | |
| SR639 Intersection | 50+68.00 | 62+60.00 | 3 | 1192.00 | 3,576 | | | |
| 460W Connector Intersection | 415+83.44 | 430+00.00 | 1 | 1416.56 | 1,417 | | | |
| 460W Connector Intersection | 423+75.00 | 429+66.00 | 1 | 591.00 | 591 | | | |
| 460W Connector Intersection | 427+25.00 | 430+00.00 | 1 | 275.00 | 275 | | | |
| 460W Connector Intersection | 431+00.00 | 437+55.00 | 2 | 655.00 | 1,310 | | | |
| 460W Connector Intersection | 64+42.00 | 73+50.00 | 5 | 908.00 | 4,540 | | | |
| 460 Interchange Ramp A | 10+00.00 | 14+00.00 | 1 | 400.00 | 400 | | | |
| 460 Interchange Ramp A | 14+00.00 | 26+80.00 | 2 | 1280.00 | 2,560 | | | |
| 460 Interchange Ramp B | 10+75.00 | 24+00.00 | 2 | 1325.00 | 2,650 | | | |
| 460 Interchange Ramp B | 24+00.00 | 31+85.00 | 1 | 785.00 | 785 | | | |
| 460 Interchange Ramp C | 10+00.00 | 14+00.00 | 1 | 400.00 | 400 | | | |
| 460 Interchange Ramp C | 14+00.00 | 25+25.00 | 2 | 1125.00 | 2,250 | | | |
| 460 Interchange Ramp D | 10+00.00 | 14+00.00 | 1 | 400.00 | 400 | | | |
| 460 Interchange Ramp D | 14+00.00 | 22+66.00 | 2 | 866.00 | 1,732 | | | |
| 460 Interchange Ramp D | 22+66.00 | 37+76.00 | 1 | 1510.00 | 1,510 | | | |
| 460 Interchange Ramp E | 10+23.00 | 11+75.00 | 2 | 152.00 | 304 | | | |
| US 460 | 61+77.00 | 86+30.00 | 6 | 2453.00 | 14,718 | | | |
| US 460 | 68+45.00 | 71+00.00 | 1 | 255.00 | 255 | | | |
| US 460 | 79+00.00 | 81+50.00 | 1 | 250.00 | 250 | | | |
| 775+00 - ET (KHA) | 10.0000 | | _ | | 206,126 | | | |
| | | | | Total | 604,859 | \$0.50 | \$302,429.59 | 10.609 |
| | | | | | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | | , | |
| Pavement Message Arrow Marking | 1 | | | | | | | |
| Location | | | | Count (EA) | Count (EA) | Cost/EA | Cost | % of Total |
| SR664 Intersection | | | | 18.00 | 18 | , | | |
| SR645 Intersection | | | | 22.00 | 22 | | | |
| SR639 Intersection | | | | 7.00 | 7 | | | |
| 460W Connector Intersection | | | | 44.00 | 44 | | | |
| 460 Interchange | | | | 8.00 | 8 | | | |
| US 460 | | | | 14.00 | 14 | | | |
| Murphy's Mill Intersection (KHA) | | | 1 | 18.00 | 18 | | | |
| General Early (KHA) | | | | 8.00 | 8 | | | |
| 7 (19 | | | | | | | | |
| | | | | Total | 139 | \$80.00 | \$11,120.00 | 0.399 |
| | | | | | | | | |

| Project: | Route 460 SEVA Preferred Alternative | Computed: | JW | Date: | 10/1/2015 | | | |
|------------------------------|---|-----------|-------------|--------------------|------------|----------|--------------|------------|
| | Cost Opinion | | | | | | | |
| Subject: | | Checked: | DB | Date: | 10/23/2015 | | | |
| Task: | Avoidance and Minimization Design | Page: | | of: | | | | |
| Job#: | 0460-969-703, 100432 | No: | | | | | | |
| | | | | | | | | |
| PAVEMENT STRIPING, MARKI | NG & SIGNING PAY I | TEMS | | | | | | |
| • | | | | | | | | |
| 50012 Road Edge Delineators | | | | | | | | |
| Location | | | Length (LF) | Delineator Spacing | Count (EA) | Cost/EA | Cost | % of Total |
| Begin and Section C | 180+90.00 | 226+18.96 | 4528.96 | 528.00 | 17 | | | |
| Section D | 226+18.96 | 236+64.23 | 1045.27 | 130.00 | 16 | | | |
| Section D | 236+64.23 | 241+36.98 | 472.75 | 528.00 | 2 | | | |
| Section D | 241+36.98 | 247+70.45 | 633.47 | 90.00 | 14 | | | |
| Sections A, B C, D, E, and F | 247+70.45 | 255+00.00 | 729.55 | 528.00 | 3 | | | |
| Sections A, B C, D, E, and F | 255+00.00 | 307+68.28 | 5268.28 | 528.00 | 20 | | | |
| Sections A, B C, E, and F | 307+68.28 | 342+25.08 | 3456.80 | 300.00 | 23 | | | |
| Sections A, B C, E, and F | 342+25.08 | 389+00.00 | 4674.92 | 528.00 | 18 | | | |
| Sections A, B C, E, and F | 389+00.00 | 415+83.44 | 2683.44 | 528.00 | 10 | | | |
| Sections A, B C, E, and F | 415+83.44 | 439+55.91 | 2372.47 | 160.00 | 30 | | | |
| Sections A, B C, E, and F | 439+55.91 | 453+73.59 | 1417.68 | 528.00 | 5 | | | |
| Sections A, B C, E, and F | 453+73.59 | 470+20.66 | 1647.07 | 300.00 | 11 | | | |
| Sections A, B C, E, and F | 470+20.66 | 480+00.00 | 979.34 | 528.00 | 4 | | | |
| Sections A, B C, E, and F | 480+00.00 | 493+00.00 | 1300.00 | 300.00 | 9 | | | |
| Sections A, B C, E, and F | 493+00.00 | 521+00.00 | 2800.00 | 300.00 | 19 | | | |
| Sections A, B C, E, and F | 521+00.00 | 585+23.80 | 6423.80 | 300.00 | 43 | | | |
| Sections A, B C, E, and F | 585+23.80 | 590+85.88 | 562.08 | 528.00 | 2 | | | |
| Sections A, B C, E, and F | 590+85.88 | 596+22.95 | 537.07 | 200.00 | 5 | | | |
| Sections A, B C, E, and F | 596+22.95 | 628+15.76 | 3192.81 | 528.00 | 12 | | | |
| Sections A, B C, E, and F | 628+15.76 | 677+36.31 | 4920.55 | 528.00 | 19 | | | |
| Sections A, B C, E, and F | 677+36.31 | 720+76.56 | 4340.25 | 230.00 | 38 | | | |
| Sections A, B C, E, and F | 720+76.56 | 735+06.96 | 1430.40 | 528.00 | 5 | | | |
| Sections A, B C, E, and F | 735+06.96 | 775+00.00 | 3993.04 | 300.00 | 27 | | | |
| 775+00 - ET (KHA) | | | | | 885 | | | |
| | | | | Total | 1,236 | \$128.13 | \$158,320.97 | 5.55% |
| | | | | | | | | |
| | | | | | | | | |

| Project: | Route 460 SEVA | Computed: | | Date: | | | | |
|------------------------------|--------------------------------------|-----------|-----------------|--------------|-------------|----------------|--------------|------------|
| • | Preferred Alternative | | JW | | 10/1/2015 | | | |
| | Cost Opinion | | | | | | | |
| Subject: | · | Checked: | DB | Date: | 10/23/2015 | | | |
| Task: | Avoidance and Minimization Design | Page: | | of: | | | | |
| Job#: | 0460-969-703, 100432 | No: | | | | | | |
| | | | | | | | | |
| PAVEMENT STRIPING, MARKING | 3 & SIGNING PAY IT | TEMS | | | | | | |
| | | | | | | | | |
| 54217 Raised Pavement Marker | T | 1 | 1 | 1 | 1 | I | | |
| Location | | | Number of Paint | Construction | Length (LF) | Cost/LF | Cost | % of Total |
| | | | Lines | Length (LF) | | | | 7 |
| Begin and Section C | 180+90.00 | 226+18.96 | 4 | 4528.96 | 226 | | | |
| Section D | 226+18.96 | 255+00.00 | 2 | 2881.04 | 72 | | | |
| Sections A, B C, E, and F | 255+00.00 | 775+00.00 | 4 | 52000.00 | 2,600 | | | |
| SR664 Intersection | 244+60.00 | 247+15.00 | 2 | 255.00 | 13 | | | |
| SR664 Intersection | 249+15.00 | 252+00.00 | 2 | 285.00 | 7 | | | |
| SR664 Intersection | 57+65.00 | 60+86.40 | 1 | 321.40 | 4 | | | |
| SR664 Intersection | 62+75.50 | 68+00.00 | 1 | 524.50 | 7 | | | |
| SR645 Intersection | 304+40.00 | 309+50.00 | 2 | 510.00 | 13 | | | |
| SR645 Intersection | 311+30.00 | 315+85.00 | 2 | 455.00 | 11 | | | |
| SR645 Intersection | 58+45.00 | 60+75.00 | 1 | 230.00 | 3 | | | |
| SR645 Intersection | 62+20.00 | 65+20.00 | 1 | 300.00 | 4 | | | |
| SR639 Intersection | 377+80.00 | 383+30.00 | 1 | 550.00 | 7 | | | |
| SR639 Intersection | 384+45.00 | 388+70.00 | 1 | 425.00 | 5 | | | |
| SR639 Intersection | 50+68.00 | 62+60.00 | 1 | 1192.00 | 30 | | | |
| 460W Connector Intersection | 415+83.44 | 430+00.00 | 1 | 1416.56 | 18 | | | |
| 460W Connector Intersection | 423+75.00 | 429+66.00 | 1 | 591.00 | 7 | | | |
| 460W Connector Intersection | 427+25.00 | 430+00.00 | 1 | 275.00 | 3 | | | |
| 460W Connector Intersection | 431+00.00 | 437+55.00 | 2 | 655.00 | 16 | | | |
| 460W Connector Intersection | 64+42.00 | 73+50.00 | 3 | 908.00 | 68 | | | |
| 460 Interchange Ramp A | 10+00.00 | 14+00.00 | 1 | 400.00 | 5 | | | |
| 460 Interchange Ramp A | 15+00.00 | 17+00.00 | 1 | 200.00 | 10 | | | |
| 460 Interchange Ramp B | 20+50.00 | 23+00.00 | 1 | 250.00 | 13 | | | |
| 460 Interchange Ramp B | 23+00.00 | 32+00.00 | 1 | 900.00 | 11 | | | |
| 460 Interchange Ramp C | 10+00.00 | 15+50.00 | 1 | 550.00 | 7 | | | |
| 460 Interchange Ramp C | 15+50.00 | 18+60.00 | 1 | 310.00 | 16 | | | |
| 460 Interchange Ramp D | 10+00.00 | 14+00.00 | 1 | 400.00 | 5 | | | |
| 460 Interchange Ramp D | 14+00.00 | 15+00.00 | 1 | 100.00 | 5 | | | |
| 460 Interchange Ramp D | 22+66.00 | 37+76.00 | 1 | 1510.00 | 19 | | | |
| 460 Interchange Ramp E | 10+23.00 | 11+75.00 | 1 | 152.00 | 2 | | | |
| US 460 | 61+77.00 | 86+30.00 | 4 | 2453.00 | 123 | | | |
| US 460 | 68+45.00 | 71+00.00 | 1 | 255.00 | 3 | | | |
| US 460 | 79+00.00 | 81+50.00 | 1 | 250.00 | 3 | | | |
| 775+00 - ET (KHA) | 75.00.00 | 51.50.05 | | 250.00 | 2,577 | | | |
| and the fact that it | | | | | 2,5 | | | |
| | | | | Total | 5,913 | \$27.00 | \$159,638.30 | 5.60% |
| | | 1 | 1 | 13(8) | 5,515 | 4 27.00 | 7133,030.30 | 3.00% |
| <u> </u> | | | | | | | | |
| | | 1 | 1 | 1 | 1 | l . | | |

| | | | | | TOTA | AL CATEGORY COST | \$2,851,790.00 | 100.00% |
|--------------------------------------|------------------------|-------------|-------------------------------------|--|----------------------------|-------------------------|----------------|------------|
| | | | | | | | | |
| | | | | Total | 4.5 | \$200,000.00 | \$900,000.00 | 31.56% |
| | | | | | | | | |
| | | | | | | | | |
| | | | General Early (KHA) | | 1 | | | |
| | | | ET (KHA) | | 0.5 | | | |
| | | | hange at Ex. US 460 | | 2 | | | |
| | | Rou | te 460W Connector | | 1 | | | |
| | | | Location | | Number of Intersections | Cost/ Intersection | Cost | % of Total |
| Traffic Signal | | | | | | | | |
| | | | | iotai | 23.0 | \$ 43,000.00 | 71,123,000.00 | 33.4376 |
| General Early (KHA) | | | | Total | 25.0 | \$45,000.00 | \$1,125,000.00 | 39.45% |
| ET (KHA) General Early (KHA) | | | | | 1 | | | |
| 460 Interchange | 180+90 - 775+00 | 59,410 | | 2 | 2 22 | | | |
| 460 Interchange | 190,00 775,00 | E0 440 | | | 2 | | | |
| Location | | Length (LF) | | Number of Sign Structures Per Location | Number (EA) | Cost/Each | Cost | % of Total |
| Signs Structures - Cantilever or Tru | ss (Including sign pan | el) | | | | | | |
| | | | | | | | | |
| | 1 | | | iotai | 3,720 | 932.30 | 7133,200.31 | 0.8376 |
| | | | | Total | 3,720 | \$52.50 | \$195,280.91 | 6.85% |
| ET (KHA) | | | | | 1,700 | | | |
| 775+00 - ET (KHA) | | 23,900 | 36 | 16 | 579 | | | |
| 180+90 - 775+00 | | 59,410 | 90 | 16 | 1,440 | | | |
| Location | | Length (LF) | Number of Signs (8 Signs per mi) | Square Footage Per Sign (Sq. Ft.) | Squar Ft of Sign | Cost/ Sq. Ft. | Cost | % of Total |
| Signs - Ground Mounted | | | | | | | | |
| | | | | | | | | |
| PAVEMENT STRIPING, MARKIN | G & SIGNING PAY IT | TEMS | | | | | | |
| Job#: | 0460-969-703, 100432 | No: | | | | | | |
| Task: | Minimization Design | Page: | | of: | | | | |
| Subject: | Avoidance and | | | | | | | |
| Cubicat. | Cost Opinion | Checked: | DB | Date: | 10/23/2015 | | | |
| | _ | | | | | | | |

| | | | ТОТ | AL CATEGORY COST | \$5,606,830.00 | 100% |
|--------------------------------------|---|-----------------------|-----------------|------------------|----------------------------------|------------|
| | | | | | | |
| | | Total | 84,910 | \$42.00 | \$3,566,220.00 | 63.60% |
| | 775+00 - ET (KHA) | | 25,500 | | | |
| Project | 180+90 - 775+00 | | 59,410 | | \$0.00 | |
| Location | 400.00 775.00 | | Length (LF) | Cost/LF | Cost | % of Total |
| ITS | | | | | | |
| | | | | | | |
| | | Total | 37,102 | \$55.00 | \$2,040,610.00 | 36.40% |
| 773700 - ET (KHA) | | | 23,000 | | | |
| Route 460 INTG. 775+00 - ET (KHA) | 01+//.00 | 80+29.00 | 2,452 23,800 | | AIUIIR EX. 400 | |
| Route 460 INTG. | 722+72.00 61+77.00 | 766+25.00 86+29.00 | 4,353 | | Along Route 460 Along Ex. 460 | |
| Route 460W | 64+42.00 | 73+86.00 766+25.00 | 944 | | Along Connector | |
| Route 460W | 412+83.00 | 439+56.00 | 2,673 | | Along Route 460 | |
| ZUNI | 226+20.00 | 255+00.00 | 2,880 | | | |
| Location | | | Length (LF) | Cost/LF | Cost | % of Total |
| Roadway Lighting | | | | | | |
| LIGHTING, 113, A | TRAITIC SIGILA | LSTATTIENS | | | | |
| LIGHTING ITS A | ND TRAFFIC SIGNA | I S DAV ITEMS | | | | |
| Job #: | 0460-969-703, 100432 | No: | | | | |
| Task: | Avoidance and Minimization Design | Page: | | of: | | |
| Subject: | Cost Opinion | Checked: | MSS | Date: | 10/23/2015 | |
| Project: | Route 460 SEVA Preferred Alternative | Computed: | DB | Date: | 10/1/2015 | |

| Project: | Route 460 SEVA Preferred Alternative | Computed: | PDG/JBH/ZS | Date: | 10/1/2015 |
|----------|---|-----------|------------|-------|------------|
| Subject: | Cost Opinion | Checked: | DB | Date: | 10/23/2015 |
| Task: | Avoidance and Minimization Design | Page: | | of: | |
| Job #: | 0460-969-703, 100432 | No: | | | |

| <mark>27550 Storm W</mark> ate | r Man. Drain. Str. Sl | NM | | | | | |
|---------------------------------|------------------------|-----------------|-------|-------------|------------|----------------|------------|
| Location | Station | Station | | Depth (LF) | Cost/LF | Cost | % of Total |
| Scroll 1 | 180+90.00 | 453+00.00 | | 91 | \$1,434.26 | | |
| Scroll 2 Scroll 3 (KHA) | 453+00.00 775+00.00 | 780+00.00 ET | | 126 119 | | | |
| SCIOII 5 (KIIA) | 773+00.00 | LI | | 119 | | | |
| | | | Total | 336 | | \$481,911.36 | 8.52 |
| 06750 Drop Inlet D | I-2B, L=10' | | | | | | |
| Location | Station | Station | | Number (EA) | Cost/Each | Cost | % of Total |
| Scroll 1 | 180+90.00 | 453+00.00 | | 67 | \$6,550.00 | | |
| Scroll 2 | 453+00.00 | 780+00.00 | | 61 | | | |
| Scroll 3 (KHA) | 775+00.00 | ET | | 149 | | | |
| | | | Total | 277 | | \$1,814,350.00 | 32.089 |
| <mark>07508 Drop Inlet D</mark> | 1-7 | | | | | | |
| Location | Station | Station | | Number (EA) | Cost/Each | Cost | |
| Scroll 1 | 180+90.00 | 453+00.00 | | 99 | \$5,888.00 | | |
| Scroll 2 | 453+00.00 | 780+00.00 | | 159 | | | |
| Scroll 3 (KHA) | 775+00.00 | ET | | 58 | | | |
| | | | Total | 316 | | \$1,860,608.00 | 32.909 |
| | | | Total | 310 | | \$1,800,008.00 | 32.30 |
| 08962 Drop Inlet D | - | | | | | | |
| Location | Station | Station | | Number (EA) | Cost/Each | Cost | |
| Scroll 1 | 180+90.00 | 453+00.00 | | 0 | \$4,055.00 | | |
| Scroll 2 | 453+00.00 | 780+00.00 | | 0 | | | |
| Scroll 3 (KHA) | 775+00.00 | ET | | 14 | | | |
| | | | Total | 14 | | \$56,770.00 | 1.009 |
| 08583 Drop Inlet D | I-14E TY. III, L=10' | | | | | | |
| Location | Station | Station | | Number (EA) | Cost/Each | Cost | % of Total |
| Scroll 1 | 180+90.00 | 453+00.00 | | 39 | \$6,268.00 | | |
| Scroll 2 | 453+00.00 | 780+00.00 | | 7 | | | |
| Scroll 3 (KHA) | 775+00.00 | ET | | 0 | | | |
| | | | Total | 46 | | \$288,328.00 | 5.109 |
| | | | Total | -10 | | ¥200,320.00 | 3.10 |
| 09056 Manhole M | | | | | | | |
| Location | Station | Station | | Depth (LF) | Cost/LF | Cost | % of Total |
| Scroll 1 | 180+90.00 | 453+00.00 | | 2 | \$950.00 | | |
| Scroll 2 Scroll 3 (KHA) | 453+00.00 775+00.00 | 780+00.00 ET | | 0 24 | | | |
| SCIOII 5 (KIIA) | 773+00.00 | Li | | 24 | | | |
| | | | Total | 26 | | \$24,700.00 | 0.449 |
| 09057 Frame & Co | ver MH-1 | | | | | | |
| Location | Station | Station | | Number (EA) | Cost/Each | Cost | % of Total |
| Scroll 1 | 180+90.00 | 453+00.00 | | 2 | \$635.00 | | |
| Scroll 2 | 453+00.00 | 780+00.00 | | 0 | , | | |
| Scroll 3 (KHA) | 775+00.00 | ET | | 3 | | | |
| | | | Total | 5 | | \$3,175.00 | 0.069 |
| | | | iUldi | э | | 33,173.00 | 0.06 |

| Project: | Route 460 SEVA Computed: Preferred Alternative | | PDG/JBH/ZS | 10/1/2015 | |
|----------|--|----------|------------|-----------|------------|
| Subject: | Cost Opinion | Checked: | DB | Date: | 10/23/2015 |
| Task: | Avoidance and Minimization Design | Page: | | of: | |
| Job #: | 0460-969-703, 100432 | No: | | | |

| 06150 15" End Sect | tion ES-1 or 2 | | | | | | |
|--------------------|---------------------|-----------|------------------|-------------|------------|--------------|------------|
| Location | Station | Station | | Number (EA) | Cost/Each | Cost | % of Total |
| Scroll 1 | 180+90.00 | 453+00.00 | | 0 | \$855.00 | | |
| Scroll 2 | 453+00.00 | 780+00.00 | | 0 | | | |
| Scroll 3 (KHA) | 775+00.00 | ET | | 53 | | | |
| | | | Total | 53 | | \$45,315.00 | 0.80% |
| 60403 Concrete Cla | iss A3 | | | | | | |
| Location | Station | Station | Size | Volume (CY) | Cost/CY | Cost | % of Total |
| Scroll 1 | 180+90.00 | 453+00.00 | EW-1's | 57 | \$1,269.00 | | |
| | | | EW-2's | 110 | | | |
| | | | EW-6's | 15 | | | |
| Scroll 2 | 453+00.00 | 780+00.00 | EW-1's | 91 | | | |
| | | | EW-2's | 157 | | | |
| | | | EW-6's | 0 | | | |
| Scroll 3 (KHA) | 775+00.00 | ET | | 216 | | | |
| | | | | | | | |
| | | | Total | 646 | | \$819,786.69 | 14.50% |
| 60404 Concrete Cla | iss A4 | | | | | | |
| Location | Station | Station | Size | Volume (CY) | Cost/CY | Cost | % of Total |
| Scroll 1 | 180+90.00 | 453+00.00 | Box Culvert EW's | 9 | \$788.00 | | |
| Scroll 2 | 453+00.00 | 780+00.00 | Box Culvert EW's | 44 | | | |
| Scroll 3 (KHA) | 775+00.00 | ET | | 62 | | | |
| | | | Total | 114 | | \$89,989.60 | 1.59% |
| 00540 Reinf. Steel | (Box Culvert EndWal | lls) | | | | | |
| Location | Station | Station | | Weight (LB) | Cost/LB | Cost | % of Total |
| Scroll 1 | 180+90.00 | 453+00.00 | Box Culvert EW's | 1,102 | \$0.10 | | |
| Scroll 2 | 453+00.00 | 780+00.00 | Box Culvert EW's | 5,509 | | | |
| | 775+00.00 | ET | | 4,092 | | | |
| Scroll 3 (KHA) | 775+00.00 | LI | | 7,032 | | | |

| Project: | Route 460 SEVA Preferred Alternative | Computed: | ed: Date: PDG/JBH/ZS | | 10/1/2015 |
|----------|---|-----------|-------------------------|-------|------------|
| Subject: | Cost Opinion | Checked: | DB | Date: | 10/23/2015 |
| Task: | Avoidance and Minimization Design | Page: | | of: | |
| Job #: | 0460-969-703, 100432 | No: | | | |

| 66239 Dry Riprap | Cl.II 38" | | | | | | |
|------------------|-----------|-----------|-------------------|--------------|----------|--------------|------|
| Location | Station | Station | Specific Location | Weight (TON) | Cost/TON | Cost | |
| Scroll 1 | 180+90.00 | 453+00.00 | Typical Outfalls | 235 | | | |
| | | | 245+70 | 14 | | | |
| | | | 246+38 | 14 | | | |
| | | | 357+76 | 8 | | | |
| Scroll 2 | 453+00.00 | 780+00.00 | Typical Outfalls | 352 | | | |
| | | | 472+61 | 8 | | | |
| | | | 692+53 | 7 | | | |
| | | | 694+68 | 7 | | | |
| | | | 700+00 | 7 | | | |
| | | | 728+33 | 8 | | | |
| | | | 745+00 | 7 | | | |
| | | | 762+00 | 28 | | | |
| Scroll 3 (KHA) | 775+00.00 | ET | | 1,596 | | | |
| | | | Total | 2,292 | \$74.00 | \$169,611.56 | 3.00 |

TOTAL CATEGORY COST \$5,655,616.00 100.00%

| Project: | Route 460 SEVA Computed: Preferred Alternative | | PDG/JBH/ZS | 10/1/2015 | |
|----------|--|----------|------------|-----------|------------|
| Subject: | Cost Opinion | Checked: | DB | Date: | 10/23/2015 |
| Task: | Avoidance and Minimization Design | Page: | | of: | |
| Job #: | 0460-969-703, 100432 | No: | | | |

| 01156 Storm Sewe | r Pipe 15" | | | | | | |
|--------------------|------------|-----------|-------|-------------|----------|----------------|-------------|
| Location | Station | Station | | Length (LF) | Cost/LF | Cost | % of Total |
| Scroll 1 | 180+90.00 | 453+00.00 | | 0 | \$60.00 | | |
| Scroll 2 | 453+00.00 | 780+00.00 | | 0 | | | |
| Scroll 3 (KHA) | 775+00.00 | ET | | 3,470 | | | |
| | | | Total | 3,470 | | \$208,200.00 | 1.53% |
| 01182 18" Conc. Pi | ре | | | | | | |
| Location | Station | Station | | Length (LF) | Cost/LF | Cost | % of Total |
| Scroll 1 | 180+90.00 | 453+00.00 | | 8,495 | \$95.00 | | |
| Scroll 2 | 453+00.00 | 780+00.00 | | 10,442 | | | |
| Scroll 3 (KHA) | 775+00.00 | ET | | 8,313 | | | |
| | | | Total | 27,250 | | \$2,588,750.00 | 18.98% |
| 01242 24" Conc. Pi | pe | | | | | | |
| Location | Station | Station | | Length (LF) | Cost/LF | Cost | |
| Scroll 1 | 180+90.00 | 453+00.00 | | 9,484 | \$100.00 | | |
| Scroll 2 | 453+00.00 | 780+00.00 | | 10,683 | | | |
| Scroll 3 (KHA) | 775+00.00 | ET | | 11,484 | | | |
| | | | Total | 31,651 | | \$3,165,100.00 | 23.21% |
| 01302 30" Conc. Pi | ne | | | | | | |
| Location | Station | Station | | Length (LF) | Cost/LF | Cost | % of Total |
| Scroll 1 | 180+90.00 | 453+00.00 | | 4,098 | \$102.00 | | 700.100 |
| Scroll 2 | 453+00.00 | 780+00.00 | | 4,322 | , | | |
| Scroll 3 (KHA) | 775+00.00 | ET | | 4,068 | | | |
| | | | Total | 12,488 | | \$1,273,776.00 | 9.34% |
| 01262 26" 6-4- 8 | | | | | | | |
| 01362 36" Conc. Pi | Station | Station | | Length (LF) | Cost/LF | Cost | % of Total |
| Scroll 1 | 180+90.00 | 453+00.00 | | 1,844 | \$162.00 | COST | /6 OI 10tai |
| Scroll 2 | 453+00.00 | 780+00.00 | | 3,718 | \$102.00 | | |
| Scroll 3 (KHA) | 775+00.00 | FT ET | | 1,407 | | | |
| | | | Total | 6,969 | | \$1,128,978.00 | 8.28% |
| | | | 10141 | 3,505 | | ψ1,120,370.00 | 0.207 |
| 01422 42" Conc. Pi | | | | | | | |
| Location | Station | Station | | Length (LF) | Cost/LF | Cost | % of Total |
| Scroll 1 | 180+90.00 | 453+00.00 | | 1,226 | \$155.00 | | |
| Scroll 2 | 453+00.00 | 780+00.00 | | 3,092 | | | |
| Scroll 3 (KHA) | 775+00.00 | ET | | 1,567 | | | |
| | | | Total | 5,885 | | \$912,175.00 | 6.69% |
| 01482 48" Conc. Pi | pe | | | | | | |
| Location | Station | Station | | Length (LF) | Cost/LF | Cost | % of Total |
| Scroll 1 | 180+90.00 | 453+00.00 | | 545 | \$208.00 | | |
| Scroll 2 | 453+00.00 | 780+00.00 | | 0 | | | |
| Scroll 3 (KHA) | 775+00.00 | ET | | 471 | | | |
| | | | Total | 1,016 | | \$211,328.00 | 1.55% |
| | | | iotai | 1,010 | | 7211,320.00 | 1.55/0 |

| Project: | Route 460 SEVA Preferred Alternative | Computed: | PDG/JBH/ZS | Date: | 10/1/2015 | | |
|-----------------|---|-----------|------------|-------------|------------|--------------|------------|
| Cubicat | Cost Opinion | Checked: | DB | Date: | 10/23/2015 | | |
| Subject: | | Спескей: | | Date: | | | |
| Task: | Avoidance and Minimization Design | Page: | | of: | | | |
| Job #: | 0460-969-703, 100432 | No: | | | | | |
| 01542 54" Conc. | Pipe | | | | | | |
| Location | Station | Station | | Length (LF) | Cost/LF | Cost | % of Total |
| Scroll 1 | 180+90.00 | 453+00.00 | | 0 | \$475.00 | | |
| Scroll 2 | 453+00.00 | 780+00.00 | | 0 | | | |
| Scroll 3 (KHA) | 775+00.00 | ET | | 186 | | | |
| | | | Total | 186 | - | \$88,350.00 | 0.65% |
| 01722 72" Conc. | Pipe | | | | | | |
| Location | Station | Station | | Length (LF) | Cost/LF | Cost | % of Total |
| Scroll 1 | 180+90.00 | 453+00.00 | | 0 | \$950.00 | | |
| Scroll 2 | 453+00.00 | 780+00.00 | | 0 | | | |
| Scroll 3 (KHA) | 775+00.00 | ET | | 255 | | | |
| | | | Total | 255 | - | \$242,250.00 | 1.78% |

| Project: | Route 460 SEVA Preferred Alternative | Computed: | PDG/JBH/ZS | Date: | 10/1/2015 | | |
|------------------|---|-----------|------------|------------|---------------------|-----------------|------------|
| Subject: | Cost Opinion | Checked: | DB | Date: | 10/23/2015 | | |
| Task: | Avoidance and Minimization Design | Page: | | of: | | | |
| Job #: | 0460-969-703, 100432 | 2 No: | | | | | |
| 00522 Concrete | Class A4 Box Culvert | | | | | | |
| Location | Station | Station | Size | Volume (CY | ') Cost/CY | Cost | % of Total |
| Scroll 1 | 180+90.00 | 453+00.00 | 6'X4' | 14 | \$1,230.00 | | |
| | | | 10'X5' | 454 | | | |
| Scroll 2 | 453+00.00 | 780+00.00 | 8'X6' | 548 | | | |
| | | | 10'X4' | 126 | | | |
| | | | 6'X4' | 726 | | | |
| Scroll 3 (KHA) | 775+00.00 | ET | | 239 | | | |
| | | | Total | 2,108 | | \$2,592,889.20 | 19.01% |
| 00540 Reinf. Ste | el | | | | | | |
| Location | Station | Station | | Weight (LB |) Cost/LB | Cost | % of Total |
| Scroll 1 | 180+90.00 | 453+00.00 | 6'X4' | 18,409 | \$0.10 | | |
| | | | 10'X5' | 96,627 | | | |
| Scroll 2 | 453+00.00 | 780+00.00 | 8'X6' | 99,283 | | | |
| | | | 10'X4' | 28,648 | | | |
| | | | 6'X4' | 94,363 | | | |
| Scroll 3 (KHA) | 775+00.00 | ET | | 48,966 | | | |
| | | | Total | 386,297 | | \$38,629.66 | 0.28% |
| 27325 Soil Stab. | Mat EC-3 Type A | | | | | | |
| Location | Station | Station | | Area (SY) | Cost/LF | Cost | % of Total |
| Scroll 1 | 180+90.00 | 453+00.00 | | 27,219 | \$11.00 | | |
| Scroll 2 | 453+00.00 | 780+00.00 | | 34,713 | | | |
| Scroll 3 (KHA) | 775+00.00 | ET | | 45,952 | | | |
| | | | Total | 107,884 | | \$1,186,719.11 | 8.70% |
| | | | | | TOTAL CATEGORY COST | \$13,637,145.00 | 100.00% |
| | | | | | | | |

| Project: | Route 460 SEVA Preferred Alternative | Computed: | SJK/DB/BG | Date: | 10/1/2015 | |
|-------------------|---|--------------------|------------|--------------|-----------------|------------|
| | Cost Opinion | | MCC | | 10/22/201E | |
| Subject: | | Checked: | MSS | Date: | 10/23/2015 | |
| Task: | Avoidance and Minimization Design | Page: | | of: | | |
| Job #: | 0460-969-703, 100432 | No: | | | | |
| | | | | | | |
| STRUCTURE PAY | ITEMS | | | | | |
| | | | | | | |
| - | <mark>/etlands and Grade</mark> | | | 1 | | |
| Location | Bridge Width (FT) | Bridge Length (FT) | Area (SF) | Cost/Sq. Ft. | Cost | % of Total |
| R646 SMR EBL | 43.3333 | 74 | 3,206.66 | \$200.00 | \$641,332.84 | |
| R646 SMR WBL | 43.3333 | 74 | 3,206.66 | \$200.00 | \$641,332.84 | |
| US258 EBL | 43.3333 | 152 | 6,586.66 | \$200.00 | \$1,317,332.32 | |
| US258 WBL | 43.3333 | 152 | 6,586.66 | \$200.00 | \$1,317,332.32 | |
| EPW 600+00 | 43.3333 | 354 | 15,339.99 | \$225.00 | \$3,451,497.35 | |
| R600 DPT EBL | 43.3333 | 127 | 5,503.33 | \$200.00 | \$1,100,665.82 | |
| R600 DPT WBL | 43.3333 | 124 | 5,373.33 | \$200.00 | \$1,074,665.84 | |
| EPW 660+00 EBL | 43.3333 | 582 | 25,219.98 | \$225.00 | \$5,674,495.64 | |
| EPW 660+00 WBL | 43.3333 | 708 | 30,679.98 | \$225.00 | \$6,902,994.69 | |
| R603 SR EBL | 43.3333 | 111 | 4,810.00 | \$200.00 | \$961,999.26 | |
| R603 SR WBL | 43.3333 | 111 | 4,810.00 | \$200.00 | \$961,999.26 | |
| EPW 706+50 EBL | 43.3333 | 570 | 24,699.98 | \$225.00 | \$5,557,495.73 | |
| EPW 706+50 WBL | 43.3333 | 645 | 27,949.98 | \$225.00 | \$6,288,745.16 | |
| US 460 EBL | 43.3333 | 193 | 8,363.33 | \$225.00 | \$1,881,748.55 | |
| US 460 WBL | 55.3333 | 193 | 10,679.33 | \$225.00 | \$2,402,848.55 | |
| PMF EBL | 43.3333 | 50 | 2,166.67 | \$200.00 | \$433,333.00 | |
| PMF WBL | 43.3333 | 50 | 2,166.67 | \$200.00 | \$433,333.00 | |
| Old Myrtle (KHA) | 86.66 | 73.41 | 6,361.71 | \$200.00 | \$1,272,342.12 | |
| Kings Fork (KHA) | 86.66 | 129.17 | 11,193.87 | \$200.00 | \$2,238,774.44 | |
| | | Total | 304 005 00 | | \$44 FF4 2C9 72 | F10/ |
| | | Total | 204,905.00 | | \$44,554,268.72 | 51% |
| NEW BRIDGES - (BI | lackwater) | | | | | |
| Location | Bridge Width (FT) | Bridge Length (FT) | Area (SF) | Cost/Sq. Ft. | Cost | % of Total |
| Blackwater River | 93.3333 | 444 | 41,439.99 | | | |
| | | | | | | |
| | | Total | 41,440.00 | \$300.00 | \$12,432,000.00 | 14% |
| | | | | | | |

| | | | TO [*] | TAL CATEGORY COST | \$88,128,061.00 | 100% |
|-----------------------------------|---|--------------------|-------------------------|-------------------|-----------------|-------------|
| | | | | | | |
| | | | | | | |
| | | Total | 319,257.69 | \$60.00 | \$19,155,461.36 | 22% |
| LI Walls (KHA) | | | 49,039.73 | | | |
| Roadway Walls (See ET Walls (KHA) | vvali Area Tab) | | 215,065.67 49,039.75 | | | |
| Perry Minnow Farm | | | 9,097.60 | | | |
| Ex. US. 460 | | | 12,253.12 | | | |
| Shiloh Drive | | | 8,419.68 | | | |
| Deer Path Trail | | | 9,067.46 | | | |
| US 258 | | | 8,489.62 7,824.79 | | | |
| Stave Mill Road | | Number of Walls | | Cost/3q. Ft. | COST | /6 OI 10tai |
| Location | 1223 | Number of Walls | Area (SF) | Cost/Sq. Ft. | Cost | % of Total |
| MSE RETAINING W | ALLS | | | | | |
| | | | | | | |
| | | Total | 59,219.70 | | \$11,986,330.79 | 14% |
| Ramp E over Ex. US 460 (KHA) | 35.33 | 218.25 | 7,710.77 | \$185.00 | \$1,426,492.91 | |
| Ramp E over On-Ramp (KHA) | 35.33 | 141.67 | 5,005.20 | \$200.00 | \$1,001,040.22 | |
| Ramp D over US 58 (KHA) | 35.33 | 219.41 | 7,751.76 | \$185.00 | \$1,434,074.73 | |
| Ramp B over Ex. US 460 (KHA) | 35.33 | 247 | 8,726.51 | \$185.00 | \$1,614,404.35 | |
| Ramp B over On-Ramp (KHA) | 35.33 | 55.67 | 1,966.82 | \$200.00 | \$393,364.22 | |
| Ramp B over US 58 (KHA) | 35.33 | 332.08 | 11,732.39 | \$225.00 | \$2,639,786.94 | |
| Ramp B over Ramp D (KHA) | 35.33 | 198.92 | 7,027.84 | \$250.00 | \$1,756,960.90 | |
| General Early (KHA) | 56.67 | 164.08 | 9,298.41 | \$185.00 | \$1,720,206.52 | |
| Ramp Structures | | | 0.00 | | | |
| Location | Bridge Width (FT) | Bridge Length (FT) | Area (SF) | Cost/Sq. Ft. | Cost | % of Total |
| NEW BRIDGES - Rai | mp Structures | | | | | |
| STRUCTURE PAY I | TEMS | | | | | |
| Job #: | 0460-969-703, 100432 | No: | | | | |
| l ack- | Avoidance and Minimization Design | Page: | | of: | | |
| Subject: | | Checked: | MSS | Date: | 10/23/2015 | |
| | Route 460 SEVA Preferred Alternative Cost Opinion | | SJK/DB/BG | | 10/1/2015 | |

| Project: | Route 460 SEVA Preferred Alternative | Computed: | DB | Date: | 10/1/2015 | |
|---------------------------|---|-----------|-------|-------|------------|--|
| Subject: | Cost Opinion | Checked: | MSS | Date: | 10/23/2015 | |
| Task: | Avoidance and Minimization Design | Page: | | of: | | |
| Job #: | 0460-969-703, 100432 | No: | | | | |
| | | | | | | |
| NON-QUANTIFIE | D COSTS | | | | | |
| | | | | | | |
| Erosion Control an | d Sedimentation | | Notes | | | |
| | Percentage of Raw Construction Cost | | | | | |
| | 0.50% | | | | | |

| Project: | Route 460 SEVA Preferred Alternative | Computed: | DB | Date: | 10/1/2015 | |
|---------------|---|-----------|-------|-------|------------|--|
| Subject: | Cost Opinion | Checked: | MSS | Date: | 10/23/2015 | |
| Task: | Avoidance and Minimization Design | Page: | | of: | | |
| Job #: | 0460-969-703, 100432 | No: | | | | |
| | | | | | | |
| NON-QUANTIFIE | D COSTS | | | | | |
| | | | | | | |
| Mobilization | | | Notes | | | |
| | Percentage of Raw Construction Cost | | | | | |
| | 8.00% | | | | | |

| Project: | Route 460 SEVA Preferred Alternative | Computed: | DB | Date: | 10/1/2015 | | |
|--------------|---|-----------|---|-------|------------|--|--|
| Subject: | Cost Opinion | Checked: | MSS | Date: | 10/23/2015 | | |
| Task: | Avoidance and Minimization Design | Page: | | of: | | | |
| Job #: | 0460-969-703, 100432 | No: | | | | | |
| NON-QUANTIF | IED COSTS | | | | | | |
| | | | | | | | |
| CEI | | | Notes | | | | |
| | Percentage of Raw Construction Cost | | 10% was used to cover the cost of temp lane closures for ramp ties along US 58, resurfacing of US 58 and Existing 460 and removal of Murphy's Mill Bridge. This will also cover construction along existing 460 and R638 tie. | | | | |
| | 10.00% | | | | | | |
| Mobilization | | | Notes | | | | |
| | Percentage of Raw Construction Cost | | 5% was used to cover the cost of temp lane closures for ramp ties along US 58, resurfacing of US 58 and Existing 460 and removal of Murphy's Mill Bridge. This will also cover construction along existing 460 and R638 tie. | | | | |
| | 5.00% | | | | | | |
| PE | | | | | | | |
| | Percentage of Raw Construction Cost | | | | | | |
| | 10.00% | | | | | | |
| Contingency | | | | | | | |
| | Percentage of Raw | | | | | | |
| | Construction Cost | | | | | | |

